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Evaluation Cost of Venture Capital for Investors and Entrepreneurs in the French Market

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ABSTRACT

This paper aims at questioning the opportunity cost of capital for venture capital investors and entrepreneurs. We have estimated the total risk is correlated with the market. Then, we have examined the variation of opportunity cost of capital, depending on the entrepreneur's diversification level, industry and financial maturity of venture capital firms. Given the entrepreneur's ability to allocate wealth between the venture and a market index, we estimate that the new venture cost of capital is generally two to four times as high as for well-diversified investors. Furthermore, we notice that total risk is likely to decline with financial maturity.

JEL Classifications: *G00, G11*

Keywords: *diversification; investment decisions; portfolio choice; rate of return; risk analysis; risk return*

I. INTRODUCTION

Financing new venture capital-backed firms involves a contract between an entrepreneur and a venture capital firm. Investors in venture capital funds have a well-diversified portfolio. However, for a start-up entrepreneur his risk is necessarily undiversified and he has to allocate a substantial fraction of his human and financial capital in the company. Consequently, the return cost required by the entrepreneur depends especially on the total risk of the firm.

Investors are attracted by venture capital because it enables them to realize potential returns that are higher than returns obtained following investment in IPOs. Equally, Venture Capital (VC) entrepreneurs are attracted by an estimated much higher return than their human and financial capital. Nevertheless, despite the dearness of data, most studies on venture capital and entrepreneurship show that returns performed by VC firms can be generally compared to returns of IPO shares and that the entrepreneurs' financial returns are generally inefficient. Moskowitz et al (2002) assume that entrepreneurs can accept an inefficient financial profitability because they benefit from nonpecuniary benefits.

Moreover, some researchers have attempted to study estimated return of venture capital investments relying on the realized returns. However, the ex-ante projection of the realized historical returns represents a biased approach for future return estimation. Cochrane (2005) considers that most studies have been carried out basically on VC IPOs or during the financing of a new stage or in the case of VC repurchasing. As a result, these events are more likely to occur when the company performs a positive return. Thus, the author considers that the average adjusted return of VC studied firms is declining from 18% to 15%.

We are developing some evaluations of the opportunity cost of capital for investors of venture capital firms (limited partners, LP) and entrepreneurs. We will check if, after an IPO, beta, the total risk and correlation with the market are systematically linked to the size of the firm, its development stage or the nature of the firm's activity.

We notice that the average beta of new IPO VC firms is approximate to that of the market and that betas are negatively correlated with the age and the size of the studied firms. As for entrepreneurs, we have managed to identify the impact of non-diversification on the opportunity cost of the capital of projects. Knowing that entrepreneurs can allocate their wealth between the venture and the market index, we find out that the new venture cost of capital is generally two to four times as high as for well-diversified investors.

The organization of this paper is as follows. Section II exposes the literature review and methodology. Section III displays the evaluation methods we use to estimate the cost of capital for venture capital investors and entrepreneurs. Section IV illustrates the results of undiversified and well-diversified analyses. Section V provides an evaluation of the cost of capital for investors and entrepreneurs. Section VI is a concluding one.

II. LITERATURE REVIEW AND METHODOLOGY

A. Returns of Venture Capital

Several researches have included the required return of venture capital investments for the study of venture capital returns funds. Bygrave and Timmons (1992) and Gompers and Lerner (1997) find that gross-of-fee returns progresses on average from 13% to 31%. *Venture Economics* notices that the realized average returns of US venture capital funds between 1981 and 2001 was 17.7%. In contrast, for the same period, the average return of realized investments in the S&P 500 was 15.6%. However, explaining the premium difference between both studies remains ambiguous; it can be justified by a compensation for investment in venture capital or simply an artifact based on selecting data. In a recent study, Cochrane (2005) finds a geometric average of realized returns on venture capital investments of 5.2 percent. However, he suggests that the distribution of venture capital returns is highly asymmetric; actually with a few large wins VC can offset many losses. Therefore, estimating the required return rate based on historical returns is unreliable. Allowing for the asymmetry of data, Cochrane (2005) finds that due to skewness, the arithmetic average is 5.7%, whereas, Moskowitz et al (2002) use data from the *Survey of Consumer Finances* and other information to document that private equity returns are, on average, not higher than returns on public equity. They conclude that a diversified public equity portfolio offers a more attractive risk-return tradeoff.

B. Entrepreneur's Return

In order to tackle the question of entrepreneur's return, Hamilton (2000) compares earnings differentials in self-employment and paid employment and suggests that self-employment results in lower median earnings. However, the return to self-employment is positively skewed and mean self-employment income is slightly higher than mean wage income. Hamilton concludes that entrepreneurs appear to be willing to sacrifice earnings for nonpecuniary benefits.

Because an entrepreneur must commit a significant fraction of his wealth to a single firm, the entrepreneur's cost of capital is readily affected by the company's total risk, correlation with risk of the entrepreneur's firm, and achievable diversification of his portfolio (Hall et al ; 2002). To estimate cost of capital, we assume the entrepreneur holds a two-asset portfolio, consisting of investments in the venture and the market.

Assuming a zero correlation between private and public equity, and an allocation of wealth between the firm and market assets, Heaton and Lucas (2001) estimate that the entrepreneur's required rate for investing in the company would be about 10 % above the market return. Similar conclusions have been reached by studies of Brennan and Torous (l999) and Benartzi (2000).

Aiming at estimating the cost of capital, we will use the suggestion of Smith et al (2004). We suppose that the entrepreneur holds a portfolio made up of two assets: one for investment and another one for the market. We examine the impact of the variation of each asset's weighting on the portfolio's total risk.

We estimate the cost of capital of an entrepreneur holding an undiversified portfolio, assuming that the entrepreneur can reject investment in the company and substitute his risky portfolio relying on market investment.

III. INVESTORS' OPPORTUNITY COST IN VC

A. Estimation of the Cost of Capital

We make use of CAPM to estimate the opportunity cost of capital for venture capital investment of well-diversified investors. Using the familiar form of CAPM, the opportunity cost of the investor's capital is defined by the following equation:

$$R_{ven}^{inv} = R_F + \rho_{ven,M}\left(\sigma_{ven}^{inv} / \sigma_M\right)\left(R_M - R_F\right) = R_F + \beta_{ven}\left(R_M - R_F\right) \tag{1}$$

where R_F is the risk-free rate, R_M is the expected return rate on the market, $\rho_{ven,M}$ is the correlation between venture returns and market returns, σ_{ven}^{inv} and σ_M is the standard deviation of venture returns and the standard deviation of market returns and β_{ven} is the venture's beta risk. Equation (1) assumes that the investor does not require any further/additional return for the venture's expected cash flows which is eventually higher than that of the market portfolio. All variables are defined over the expected holding period, i.e., from time of investment to expected time of harvest. The standard deviation measures in the equation as well as the measure of beta are based on the *equilibrium* holding period return hypothesis for a well-diversified investor.

As Equation (1) explains, the opportunity cost of capital depends on equilibrium returns, the opportunity cost of capital and the return standard deviations are simultaneously determined. In practical applications, CAPM users circumvent this problem by inferring project betas from data on comparable markets. But when data are not available, the certainty-equivalent form of the CAPM is more convenient. We use the equation of the certainty-equivalent cash-flows to display the consequence of underdiversification on the cost of capital. Using the standard deviation of cash-flows is chosen rather than standard deviation on the *equilibrium* holding period return.

The Equation of the certainty-equivalent cash-flows is as follows:

$$PV_{ven}^{inv} = \frac{C_{ven} - \dfrac{\rho_{ven,M}\ \sigma_{C_{ven}}}{\sigma_M}\left(R_M - R_F\right)}{1 + R_F} \tag{2}$$

where, C_{ven} is the expected future cash-flows, σ_{Cven} is the standard deviation of cash-flows. The present value, PV_{ven}^{inv}, can be estimated following calculations of the standard deviation of cash-flows σ_{Cven} and correlation between venture return rate and the market, $\rho_{ven,M}$. It is wise to check the assumption related to σ_{Cven}, the resulting value can be used to calculate the implicit values of standard deviation returns for investors over the holding period, σ_{ven}^{inv}, and venture beta β_{ven}. These estimations can be compared to comparable firms' betas. Thus, the investor's opportunity cost of capital is obtained by dividing cash-flows future returns out of the present value minus one.

B. Critical Risk of Venture Capital Funds and Under-Diversification

As a venture capital fund is a conduit for investing in start-ups, its under diversification is no different than that of any public firm. Our assumption that limited partners are well diversified is supported by the fact that most venture capital is provided by large institutions that allocate only small fractions of total resources to “alternative investments” including venture capital. The historical realized returns to venture capital investing are consistent with financial economic theory. Evidence on public venture capital portfolios and venture capital-backed public firms indicate that the betas range from less than 1.0 to around 2.0. For instance, Gompers and Lerner (1997) find a portfolio beta of 1.08. For a broader sample, Cochrane (2001) reports maximum likelihood estimates of 0.88 to 1.03 against the S&P500 (and 0.98 to 1.29 against the NASDAQ Index). Furthermore, Smith et al (2001) use an average venture capital beta in public equity of the American market between 1995 and 2000 of 0.993 (0.717) compared to S&P 500 (Nasdaq).

C. Illiquidity of VC Investments

Estimations of the cost of capital include the consequence of illiquidity in portfolio diversification. The following section shows that the opportunity cost of capital for investing in venture capital or private equity increases with illiquidity and with under-diversification. The longer a party is constrained to hold an inefficiently diversified portfolio, the greater is the consequence of under-diversification on the certainty-equivalent value of the portfolio at harvest. Additionally, the entire penalty for under-diversification is assessed against the over-weighted asset in the portfolio (i.e., the investment in the venture). Thus, illiquidity, as reflected by expected time until harvest, affects the entrepreneur’s cost of capital for investing in the venture. Because, by assumption, investment in the venture is a trivial fraction of the well-diversified investor’s portfolio, illiquidity does not affect the investor’s cost of capital.[1]

In the estimations of the cost of capital for well-diversified investors, we do not make any adjustment for illiquidity due to information asymmetry. Illiquidity adjustments to discount rates are realized when the investor holds information that encourage him to keep his assets for a longer time. Nonetheless, the limited partners who choose to invest in venture capital funds are passive and are unlikely to be sacrificing returns to their own information-trading efforts.

Although there is no reliable way to observe the compensation that investors require to invest in illiquid assets, the evidence of realized returns to venture capital suggests that there is a return premium for the assets’ illiquidity.

IV. ENTRPRENEUR’S COST OF CAPITAL

Although many studies were meant to estimate the hurdle rate for entrepreneurial investments and based on risk aversion, only few researchers were interested in estimating the entrepreneur’s cost of capital. Though, the cost of capital is a fundamental criterion in the decision. Risk tolerance cannot justify an investment that is expected to provide total benefits that are less than the expected similar return on the market.

Choosing an investment depends on the estimation of the cost of capital depending essentially on the risk level and diversification. Equally important is the evaluation cost which occurs in designing financial contracts between entrepreneurs and investors.

A. Entrepreneurs' Full Commitment Case

First of all we consider the case of an entrepreneur and his cost of capital and who is fully committed to the venture. This is a situation where the entrepreneur has to choose either irrevocably committing all his financial and human capital in a venture project or investing that wealth on the market portfolio. These assumptions will be relaxed later. Since the entrepreneur has to commit all his wealth in the venture, he is able to diversify his risk and therefore, his cost of capital depends immediately on the total risk of the project. Thus, the entrepreneur's cost of capital is:

$$PV_{ven}^{Ent} = R_F + \left(\frac{\sigma_{ven}^{Ent}}{\sigma_M}\right)(R_M - R_F) \quad (3)$$

where $\left(\frac{\sigma_{ven}^{Ent}}{\sigma_M}\right)$ is the entrepreneur's standard deviation return divided by market standard deviation return over a given period of time. However, the application of the relation to estimate the entrepreneur's cost of capital is not possible for public equity firms because σ_{ven}^{Ent} is estimated on the entrepreneur's return over a given period of time. In order to face this problem, we calculate the certainty-equivalent commitment of the entrepreneur. The certainty-equivalent model is derived from the CAPM model:

$$PV_{ven}^{Ent} = \frac{C_{ven} - \frac{\sigma_{C_{ven}}}{\sigma_M}(R_M - R_F)}{1 + R_F} \quad (4)$$

Due to the lack of evidence, we use data about comparable public equity firms in order to calculate the standard deviation of the entrepreneur and the risk premium in relation to under-diversification.

B. Partial- Commitment Case

In practice, entrepreneurs can allocate only a fraction of their human and financial capital. Nevertheless, they have to commit large fractions of their total wealth in the venture project, which results in a substantially under-diversified portfolio. To examine how under-diversification affects the entrepreneur's cost of capital, we consider an entrepreneur who can allocate a portion of wealth to a well-diversified portfolio (the market portfolio).

We use a three-step process to estimate the entrepreneur's cost of capital to invest in a Venture (Smith et al, 2004). First, we estimate the standard deviation of returns on the entrepreneur's total portfolio. Second, we use the CAPM to estimate portfolio opportunity cost. Third, we set portfolio opportunity cost equal to the weighted average of the opportunity costs of the market and the venture, and solve for venture opportunity cost of capital.

The standard deviation of returns of the entrepreneur's two-asset portfolio is given by the following expression:

$$\sigma_{port} = \sqrt{\chi_{ven}^2 \sigma_{ven}^2 + \chi_M^2 \sigma_M^2 + 2\chi_{ven}\chi_M \rho_{ven,M} \sigma_{ven} \sigma_M} \quad (5)$$

where χ_{ven} and χ_M are the fractions of the entrepreneur's wealth invested respectively in the venture and the market.

The substitution σ_{port}^2 and σ_{ven}^2 in the certainty-equivalent equation which is obtained from the CAPM standard equation (Fama, 1977) makes it possible to calculate the cost of capital of the entrepreneur's portfolio R_{port}. As the cost of capital of the portfolio is the weighted average of the opportunity cost of capital of the venture and the market. So,

$$R_{port} = \chi_{ven} R_{ven} + \chi_M R_M \quad (6)$$

Due to a lack of assumptions of a series of returns, a direct estimation of equations (5) and (6) is not possible. The certainty-equivalent approach provides a solution and portfolio cash-flows of the entrepreneur and the standard deviation of these returns are presented as follows:

$$C_{port} = C_{ven} + w_M (1 + R_M) \quad (7)$$

$$\sigma_{C_{port}} = \sqrt{\sigma_{C_{ven}}^2 + (w_M \sigma_M)^2 + 2\rho_{ven,M} \sigma_{C_{ven}} (w_M \sigma_M)} \quad (8)$$

where w_M is a fraction of the entrepreneur's wealth invested in the market. The standard deviation and the value of the entrepreneur's diversified investment are estimated in relation to market cash-flows. Hence, the present value of venture investment is directly estimated, deducing the entrepreneur's investment value that is realized in the market,

$$PV_{ven}^{Ent} = PV_{port}^{Ent} - w_M$$

$$PV_{ven}^{Ent} = \frac{C_{port} - \frac{\sigma_{C_{port}}}{\sigma_M}(R_M - R_F)}{1 + R_F} - w_M \quad (9)$$

Equation (9) highlights the impact of diversification on the venture value following the assumption that investment on the market has a zero present value. We also point to the fact that the above evaluation is based on market-invested cost of capital, but it does not include the entrepreneur's personal risk tolerance.

Because, based strictly on risk and expected return, private value cannot exceed the value of an alternative equally risky investment in a well-diversified market portfolio (well-diversified portfolio).

Equation (9) is an upper bound on the entrepreneur's investment value. Assuming that the entrepreneur's personal risk tolerance is marginal and similar to market risk tolerance, equation (9) estimates the investment's net present value. However, the minimum return rate is,

$$R_{ven}^{Ent} = \frac{C_{ven}}{PV_{ven}^{Ent}} - 1 = R_F + \frac{\left(\frac{\sigma_{C_{port}}}{\sigma_M} - w_m\right)(R_M - R_F)}{PV_{ven}^{Ent}} \quad (10)$$

Equation (10) enables us to calculate the cost of capital whereby evaluating VC is possible. The illiquidity and under-diversification effects of the investment on the cost of capital are incorporated in equation (10).

The calculation of equations (9) and (10) rests upon market data in estimating market risk and correlation between VC firms and the market. Thus, they do not enable investors to use Risk-Adjusted Discount Rate (RADR) during the evaluation of expected cash-flows. But, it is possible to make use of data which is provided by comparable public equity firms.

V. ESTIMATION OF VC COST OF CAPITAL

In this section, we display estimation results of the investors' and entrepreneurs' cost of capital. Equation (1) is used for beta estimation of a well-diversified investor. In addition, the entrepreneur's cost of capital is illustrated through the estimation of equations (9) and (10). For this reason, we need to calculate a well-diversified investor's return risk and then, to estimate market correlation.

A. Data and Methodology

In this study, we have chosen a sample of French market IPOs recorded between 1997 and 2007. During this period, we have identified 146 VC. Then, we use market segmentation into 10 market industries as table 1 shows. The conclusions of Smith et al (2004) correspond to VC return within a year.

Table1

Description of sample

Industry	Firms	Observations In sample	Average Firm-years	Average sale	Average Return
Biotechnology	13	52	3.9	964.8	25.2
Business/Finance	10	33	3.6	2181.8	20.5
Communications	8	49	4.6	188.8	-23.8
Computer equipment	16	89	4.4	206.8	13.7
Computer Software	26	133	4.5	95.4	1.5
Health care	7	53	4.4	202.9	11.3
Industry / Energy	23	84	4.1	4090.4	-32.9
Retail and media	36	135	3.8	115.9	10.8
Semiconductors	7	39	4.0	79.7	2.4
All	146	667	4.1	902.9	3.2

Source: Datastream.

Thus, the same VC generates several observations of the sample which is measured as more than a year since the IPO. Assuming that the retained series of firms are altogether continuously public equity firms, we have used weekly data to calculate weekly returns. Actually, based on Datastream, we have gathered weekly quotations of various assets used to calculate each observation's return. Thus, we have preserved all the observations with no less than 30 weekly returns (Smith et al; 2004). Applying this method, we were finally able to retain 667 observations. VC age is measured as years since the IPO. We have equally made use of the Diane database so that to recover the accounting information for each company in the sample. Results and turnover have been used as an indicator of ventures' financial maturity and size. Moreover, we have retained the SBF 250 market index as a benchmark in order to calculate the beta values. As a consequence to divergence between the choice of the studied period, interval of return calculation and market index, practitioners often find out different versions of estimated beta. In addition, professionals adjust their regression to a beta equal to one. As a result, we have chosen the Bloomberg method which estimates the adjusted beta in the following way:

$$\text{adjusted beta} = \text{regression beta} *(0.67) + 0.33$$

B. Bivariate Results

1. Beta

Table 2 illustrates descriptive results (average, and standard deviation) of VC beta, French Market IPOs, estimated using the SBF 250 market index. The results are reached on average for a well-diversified investor.[2] It shows an average beta value for the entire sample which is almost 0.5. This beta hides a large variability between market industries at 0.2 for health care up to 0.83 in semi-conductor.

Following the example of Smith et al (2004), we have found, for most years, an average beta less than 1 according to the SBF 250 index. Our conclusion seems different from that of Gompers and Lerner (1997) who found that one group of investors' beta is equal to 1.08. However, based on a larger sample, Cochrane (2001) estimates, using a maximum of likelihood, one beta comprised between 0.88 and 1.03 regarding the S&P 500 index. The sample segmentation of VC per market industry shows an important variability among the estimated beta values. But, average betas are sensitively less than 1, while remaining statistically different from 1 at a threshold of 1%.

Studying the distribution of the beta values has allowed us to notice the variability over the years. In 1997 and 2000 the beta displays a 0.8 value and a minimum level along 2003. Beta increase in 2000 is due to a significant market capitalization of high-tech assets. In addition, there was also the financial Bubble which caused a high volatility in stock markets. Besides, market recession and bankruptcy of many technology ventures had lowered the size of market capitalization for these firms, which explains the low estimated beta value in 2003. Nevertheless, t-statistics calculation shows that the estimated beta values are significantly different from 1 in all years.

Table2

Summary of results using the “SBF 250 index” as a market proxy

		Betas		Adjusted Betas		Standard deviation		Relative standard deviation		Correlation	
	Obs.	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
All	667	0.50$^{\gamma}$	0.74	0.51$^{\gamma}$	0.74	0.08^{a}	0.05	3.08^{a}	1.92	0.01^{a}	0.00
Industry											
Biotechnology	52	0.59$^{\gamma}$	0.57	0.72$^{\gamma}$	0.38	0.07^{a}	0.05	2.69^{a}	1.76	0.03	0.14
Business/Finance	33	0.46$^{\gamma}$	0.86	0.64$^{\gamma}$	0.58	0.08^{a}	0.07	3.27^{a}	1.98	0.02	0.16
Communication	49	0.78$^{\gamma}$	1.19	0.85$^{\gamma}$	0.80	0.11^{a}	0.06	4.33^{a}	2.32	-0.02	0.15
Computer equipment	89	0.23$^{\gamma}$	0.55	0.48$^{\gamma}$	0.37	0.08^{a}	0.05	3.26^{a}	1.75	-0.02	0.15
Computer Software	133	0.41$^{\gamma}$	0.76	0.61$^{\gamma}$	0.51	0.08^{a}	0.05	3.16^{a}	1.76	0.02^{c}	0.16
Health care	53	0.20$^{\gamma}$	0.40	0.46$^{\gamma}$	0.27	0.06^{a}	0.05	2.72^{a}	2.39	0.03	0.15
Industry / Energy	84	0.29$^{\gamma}$	0.55	0.52$^{\gamma}$	0.37	0.06^{a}	0.03	2.56^{a}	1.65	0.01	0.17
Retailers and media	135	0.49$^{\gamma}$	0.76	0.66$^{\gamma}$	0.51	0.07^{a}	0.04	2.92^{a}	1.93	0.03^{b}	0.17
Semi-conductors	39	0.83$^{\gamma}$	0.71	0.89$^{\gamma}$	0.48	0.09^{a}	0.04	3.37^{a}	1.35	0.03	0.18
Calendar Year											
1997	4	0.80$^{\delta}$	0.80	0.80$^{\gamma}$	0.51	0.07^{a}	0.02	2.85^{a}	0.84	0.00	0.12
1998	21	0.50$^{\gamma}$	0.60	0.65$^{\gamma}$	0.41	0.10^{a}	0.05	2.44^{a}	1.19	0.03	0.15
1999	31	0.30$^{\delta}$	0.80	0.54$^{\gamma}$	0.53	0.09^{a}	0.05	3.71^{a}	2.03	0.02	0.13
2000	53	0.80$^{\gamma}$	1.30	0.86$^{\gamma}$	0.90	0.11^{a}	0.05	3.75^{a}	1.90	0.01	0.18
2001	66	0.40$^{\gamma}$	0.60	0.60$^{\gamma}$	0.41	0.10^{a}	0.05	3.27^{a}	1.70	0.02	0.16
2002	73	0.50$^{\gamma}$	0.70	0.67$^{\gamma}$	0.45	0.11^{a}	0.08	2.60^{a}	1.90	0.02	0.12
2003	75	0.10$^{\gamma}$	0.60	0.39$^{\gamma}$	0.38	0.08^{a}	0.05	2.32^{a}	1.31	0.00	0.16
2004	76	0.04	0.60	0.60$^{\gamma}$	0.42	0.07^{a}	0.04	3.58^{a}	2.38	0.02	0.15
2005	76	0.50$^{\gamma}$	0.80	0.63$^{\gamma}$	052	0.05^{a}	0.03	4.33^{a}	2.18	-0.06^{a}	0.17
2006	91	0.50$^{\gamma}$	0.70	0.69$^{\gamma}$	0.45	0.06^{a}	0.04	2.93^{a}	1.80	0.04^{a}	0.14
2007	101	0.40$^{\gamma}$	0.50	0.63$^{\gamma}$	0.34	0.05^{a}	0.03	2.28^{a}	1.17	0.06^{a}	0.19
Age											
0 -1	173	0.6$^{\gamma}$	0.92	0.68$^{\gamma}$	0.62	0.09^{a}	0.06	3.31^{a}	2.03	0.00	0.16
1-2	96	0.5$^{\gamma}$	0.78	0.62$^{\gamma}$	0.52	0.09^{a}	0.06	3.01^{a}	1.84	0.05a	0.17
+3	398	0.4$^{\gamma}$	0.64	0.60$^{\gamma}$	0.43	0.07^{a}	0.05	3.00^{a}	1.89	0.02a	0.16
Net Income											
NI < 0	205	0.7$^{\gamma}$	0.9	0.77$^{\gamma}$	0.61	0.65^{a}	0.91	4.06^{a}	2.35	0.00	0.16
NI > 0	462	0.3$^{\gamma}$	0.6	0.56$^{\gamma}$	0.43	0.35^{a}	0.64	2.65^{a}	1.51	0.03^{a}	0.16
Sale											
0 – 20	193	0.7$^{\gamma}$	1.0	0.79$^{\gamma}$	0.64	0.68^{a}	0.96	3.80^{a}	2.43	0.02	0.17
20 – 45	138	0.4$^{\gamma}$	0.7	0.58$^{\gamma}$	0.45	0.38^{a}	0.68	3.07^{a}	1.64	0.01	0.15
45 – 200	167	0.6$^{\gamma}$	0.65	0.63$^{\gamma}$	0.43	0.45^{a}	0.65	3.05^{a}	1.83	0.02	0.16
+200	169	0.2$^{\gamma}$	0.47	0.47$^{\gamma}$	0.31	0.20^{a}	0.47	2.29^{a}	1.07	0.03^{c}	0.16

“a”, “b” and “c”: indicate significance, at the 10%, 5% and 1% level of risk, respectively .γ: significantly different from 1 at the 1% level of risk, δ : significantly different from 1 at the 5% level of risk and λ : significantly different from 1 at the 10% level of risk.

As the financial literature reveals, VC firms which generate a positive net result exhibit the highest beta values as compared to VC firms which have a negative result. Within a similar framework, the study of Smith et al. (2004), which was conducted on a sample of American IPO VC firms between 1995 and 2000, confirms this result. Sample observations in terms of the criteria of age, turnover, and the VC firms’ net results (indicators of firm’s maturity according to Smith et al., 2004) show that the initially high specific risk is likely to decrease with financial improvement and the expected return. Moreover, t-statistics’ calculations show that the estimated beta values are different from 1 at the threshold of conventional significance.

2. Adjusted beta

Adjusted beta values that are estimated on the basis of the SBF 250 market index for French VC during a one-year period are illustrated in table n°2. The average adjusted beta of the sample is 0.51. This adjustment has reduced disparities between estimated values in the chosen observations of the total sample. This is confirmed by a series of standard deviations included in the interval [0.27; 0.9].

We point to the fact that all group average beta values are significantly different from 1 at a threshold of 1%. Repairing the total sample by industry confirms the risky character of both industries: “Communication” and “semi-conductors” and these were checked through a simple beta calculation. The evolution of a year-adjusted beta risk shows a 0.86 maximum average value in 2000. Nonetheless, beta risk decreases significantly and reaches a minimum during 2003. This can be explained by the market restructuring effect following the stock market crash and the decrease of IPO VC numbers which were exchanged on the market.

The effect of the venture’s maturity on the adjusted beta is similar to the simple beta. We observe a decrease in the adjusted beta values with the increase of the VC age and the improvement of the financial situation. In fact, Smith et al (2004) have proven that during the starting period, VC firms are differentiated by a negative net income and they constantly search for an outside funding so as to maintain their development. However, more mature VC firms will likely produce positive incomes and develop financial resources from within, which reduces their risk.

3. Standard deviation of VC return

The estimation of the well-diversified investor’s cost of capital is founded on total risk calculation and correlation with the market through a series of IPO VC returns. Table n°2 displays descriptive statistics in relation to annual standard deviation of well-diversified investors’ returns in the studied period. On average, the annual standard deviation of returns in our sample is 8%. Positive differences between average and median return values confirm that there exists a positive skewness. These results match the conclusions reached by Smith et al. (2004).

We have found out that the « communication » industry has the highest risk (11%), while the “health care” industry exposes the lowest risk (6%). The average total risk significance test by industry proves to be different from zero to be 1%, which means that well-diversified investors are dependent on the market industry that determines the cost of capital. We equally deduce that the VC total risk is tightly linked to the stock market cycle. Indeed, standard deviation average values usually increase during the financial crisis, then they decrease significantly in the subsequent years.

In addition, the estimations of the total risk diminish slightly with the increase of the age of the companies and their turnovers, which partly explains the decrease of the beta values referring to the same retained criteria.

Nevertheless, we notice an increase of the standard deviation for the total sample together with a decline of the net profit that varies from 35% to 65%.

These results consolidate the idea that the VC total risk decreases when the firm attains its financial maturity. This conclusion is in tune with that of Smith et al. (2004) which implies that the VC financial maturity must correspond to the decline of the total risk and the contingent increase of the market risk. Thus, there might be a considerable disparity between the under-diversified entrepreneur's cost of capital and the well-diversified investor in the starting period and the development of the VC.

4. VC relative volatility

Relative volatility estimation offers an alternative to bypass the estimation of the correlation term between the assets and market index that are necessary to betas calculation. However, the relative volatility calculation presumes that the total risk is perfectly correlated to the market risk (Damodaran, 1999). The whole sample has a relative risk which is more than three times higher than the risk incurred from investment in the market index. The examined average relative volatility by industry shows that VC companies are the most risky firms on the market. The highest risk is for the ventures belonging to the "communication" industry, however, the "industry/energy" industry represents 2.5. These results are coherent with the conclusions of Smith et al, (2004) who found that the ventures' total risk values are around four times the risk of the S&P500 market index. They justify these conclusions by the innovating VC, which affects their total risk level. This is proven by the existent disparity between relative volatility values between the industries. Definitely, the more innovative the industry is, the most significant is the ratio. During 2000 and 2005, relative risk ratio was the highest in technology VC, compared with other chosen years in the present study. These results are in tune with previous studies on markets structure which raised a considerable number of high-technology IPOs, which is, therefore, too risky, in 2000, and which later resulted in the financial Bubble. The time distribution of the relative volatility coincides with periods of mass IPOs.

We equally notice that the relative volatility tends to diminish significantly with the venture's age and turnover. According to the evidence, the relative risk is likely to increase with the deterioration of the firms' financial situation. Actually, the total risk is twice higher than the market risk once the company produces a positive net profit; it will increase up to four times if the venture has a negative income.

5. VC correlation with benchmark (market index)

Generally, the correlation of IPO VC return and market returns are low. Like most new IPOs, VC are potentially investors' targeted, which explains the independence of the expectations of their future cash-flows regarding cash-flows anticipations of the whole stock market.

The average correlation of our sample is 0.01. The segmentation of our sample by industry enables us to better understand the relation VC returns and market index. In fact, we notice that market industries present a correlation that approaches zero. Nonetheless, the « Communications » and « electronic equipment » industries have a negative correlation (-0.02). But, the evolution of these firms' returns is independent from the global economic activity. Furthermore, time-series distribution of correlations reveals variability across the years. We notice an increase of correlation in the last chosen years (2006 and 2007, respectively, 0.04 and 0.06) with a negative value in 2005 (-0.06).

C. Multivariate Regression

This section exposes regression models and also the results, using 3 variables: beta, correlation with the SBF 250 index and standard deviation on the basis of an annualized calculation. The estimation of these models highlights the relation between each VC firm's risk and the variables of the previous section. These variables examine the simultaneous effect of the VC firm's age, industry, the IPO year and the venture's financial situation. In this respect, we used again the model of Smith et al (2004) which has been tested during the American VC IPO. This specification estimates the age effect for each market industry, but the estimation of net result coefficients and turnover presumes that they are uniform across market industries. In addition, dummy variables make it possible to fathom a specific effect of the year of the VC IPO. In order to estimate the VC standard deviation, an additional variable is introduced in the regression which is related to market standard deviation that is calculated in the same studied period.

Following the earlier analysis results, VC total risk is positively correlated with the market risk. Indeed, the increase of the market risk engenders an increase of the ventures' total risk to be 0.61%. Moreover, this result's significance corroborates links between the firm's risk and the market's risk. Furthermore, the IPO VC total risk is negatively correlated with firms' financial maturity in all market industries except the Biotechnology industry.

Our results show that there is a negative and significant relation of 1% between the VC total risk and the net profit and turnover variables. Actually, an improvement of the firm's net profits entails a decrease of the total risk (35%).

Similarly, if the venture makes a turnover which is higher than the average in its industry, its total risk is reduced to be 1.8%. These relations confirm the conclusions of the bivariate analysis. These results correspond to the theory of signals which admits that positive signals comfort the investors and reduces assets' volatility.

Correlation analysis shows important variations depending on the sector, though it is statistically insignificant. In addition, we notice that if a VC as an IPO in "Retail and media" industry, its market correlation is 6.6%. The positive net profit, then, reduces VC correlation with the market to 3.3%. But, these results are not important. The retained-year effect for each observation on the correlation between VC return and market return is significantly less important than the one observed in 2007, the reference year.

As a matter of fact, we found out that the beta risk is largely variable, depending on the industry and that it diminishes in terms of the venture's age. In other words, the beta risk decreases with the firm's financial maturity. Our remark joins the previous studies; as Damodaran (2002) and Smith et al. (2004) who consider that VC firms' beta has to decrease with the financial maturity and to converge to one. Besides, we notice that the beta is lower for VC firms with a positive net profit. Indeed, an improvement of 1% for the net profit results in a 28.2% decrease of the beta risk.

To conclude, we can say that it is of great importance to precise the adjustment quality of regression models is relatively good with an adjusted R^2 of 33% and 17% respectively in order to estimate the total risk and the beta. Our conclusion is confirmed by Fisher test which proves to be significant for all the tested risk models.

VI. ILLUSTRATION OF THE VC COST OF CAPITAL

Table 3 reports on the estimation results of the under diversified entrepreneur's and well-diversified VC investors' cost of capital for the total sample and by VC industry. These results' simulation rests upon fixing the values of some variables: the annualized standard deviation of the market is assumed to be 15%, the risk-free rate is assumed to be 4% and the market return is assumed to be 10%. The beta values and correlations with the market are computed from Table 2. We also presume that entrepreneurs' and investors' commitment to the VC firms' capital is maintained during 2 years.

A. Well-diversified Investors' Cost of Capital

When correlation with the market is 0.15% and the beta is 0.67, well-diversified investors' cost of capital in the total sample is 14.3%. We notice that the cost of capital is varying across industries. For example, we use a 0.23 correlation and a 1.19 beta in the "Communication" industry, where well-diversified investors require a 19.1% rate. Although the cost of capital seems to be very low, we notice that this estimation is based on a hypothesis, that is risk-free rate and the risk premium of the stock market are lower than the historical averages, but they are still recognized in the stock market. We should also note that VC investors do not introduce any liquidity premium in the cost of capital, since they act like institutional well-diversified investors who rarely need liquidity.

B. The Entrepreneur's Cost of Capital

Table 4 analyses the sensitivity of the under diversified entrepreneur's cost of capital. Equations (9) and (10) estimate the cost of capital of an entrepreneur who committed all of his wealth in the VC to an entrepreneur who must commit his whole wealth (w_{market} must be zero). For instance, from all the observations, we can say that an entrepreneur who commits all his wealth in the VC, bears a 66.6% cost of capital. This rate is considerably variable across the market industries and it can reach 91.6% for VC IPOs in the "Electronic equipment" industry.

In order to carry out our estimations of a partial commitment case, we use various investment percentages made by the VC entrepreneur and these are between 15 % and 35%. In their conclusions, Smith et al (2004) have justified this choice, saying that an entrepreneur can invest more than 35% of his wealth in a VC.

To begin with, we assume that an entrepreneur has to invest 35% of his wealth in the VC, and the remaining part of his wealth will be invested in the market index. The entrepreneur's cost of capital is equal to 44.8%. Afterwards, the VC committed wealth is assumed to reach 25%. The entrepreneur's cost of capital is assumed to be 37.7%. With a commitment that is assumed to be 15%, the entrepreneur's cost of capital further decreases and it is 28.9%. Thus, the reduction of the capital portion that is held by the venture's entrepreneur; it transfers the risk to well-diversified investors and reduces our entrepreneur's cost of capital.

Nevertheless, even if the risk of a low commitment of the entrepreneur in the VC firm's capital and what remains of its wealth is invested in the market index, the required cost of capital is always higher than the required cost of capital of the well-diversified VC investor.

Table 3

Multivariate regressions results of French EVC risk between 1997 and 2007

Our sample consists of 667 observations annualized listed on the French market between 1997-2007. Regressions include both industry dummies for the intercept term and industry dummies interacted with the Age variable for the slope of the Age variable. Biotechnology is the baseline industry for the regressions. The baseline year is 2000. The market standard deviation is estimated from weekly returns for the contemporaneous year. Firm Age is measured as years since the IPO. Revenue equals one if the observation is associated with positive revenues and zero otherwise. Sale equals one if sale is higher than mean and zero otherwise. For the first year in a series, a binary ("No Lag") variable is included and the lagged dependent variable value is zero.

	Standard deviation		Correlation		Beta	
Variables	Coefficient	t-Stat	Coefficient	t-Stat	Coefficient	t-Stat
C (S_8 , A_{2007})	0.052	2.05[b]	0.011	1.71[c]	0.581	2.93[a]
A_{1997}	-0.002	-0.10	0.077	-1.01	0.435	1.18
A_{1998}	0.020	0.74	-0.084	-0.40	-0.024	-0.13
A_{1999}	0.024	2.52[a]	-0.016	-1.05	-0.153	-0.98
A_{2000}	0.035	2.45[a]	-0.037	-1.40	0.223	2.10[a]
A_{2001}	0.024	1.98[b]	-0.041	-2.31[a]	-0.063	-0.52
A_{2002}	0.022	0.78	-0.046	-1.67[c]	0.017	0.15
A_{2003}	0.001	0.05	-0.041	-2.48[a]	-0.403	-3.61[a]
A_{2004}	0.006	0.60	-0.063	-1.62[c]	-0.075	-0.69
A_{2005}	0.002	0.14	-0.040	-4.79[a]	-0.042	-0.39
A_{2006}	0.006	0.91	-0.116	-1.01	0.073	0.72
Age* S_9	0.001	0.43	-0.023	-0.59	0.044	1.17
Age* S_1	-0.009	-2.66[a]	-0.005	-0.03	-0.096	-2.19[b]
Age* S_2 ,	-0.004	-2.58[a]	0.000	-1.18	0.018	0.65
Age* S_3	-0.005	-2.22[b]	-0.007	-0.89	-0.084	-2.14[b]
Age* S_4	-0.004	-2.89[a]	-0.008	-1.37	-0.004	-0.15
Age* S_5	-0.002	-0.69	-0.008	0.44	0.068	2.23[b]
Age* S_6	0.000	0.07	0.004	1.07	0.011	0.33
Age* S_7	-0.002	-1.01	0.008	1.69[c]	0.012	0.47
Age* S_8	-0.002	-0.81	0.009	1.16	0.026	0.62
Biotechnology	0.065	3.57[a]	0.011	-0.37	0.518	1.75[c]
Business/Finance	0.040	2.98[a]	-0.025	-0.59	-0.216	-0.96
Communication	0.065	4.12[a]	-0.030	-0.30	0.748	2.83[a]
Computer equipment	0.035	2.68[a]	-0.018	0.42	0.052	0.24
Computer Software	0.020	1.29	0.021	-0.56	-0.374	-1.87[c]
Healthcare	0.008	0.58	-0.033	-1.27	-0.067	-0.29
Industry / Energy	0.018	1.41	-0.066	-0.99	0.105	0.51
Retailers and media	0.029	1.82[c]	-0.046	-0.85	0.347	1.30
Nolag	-0.005	-0.82	-0.051	-1.78[c]	0.176	1.68[c]
RI	-0.035	-9.18[a]	-0.033	1.20	-0.282	-4.48[a]
Sale	-0.018	-3.05[a]	0.017	0.50	-0.079	-0.81
σ_{market}	0.610	2.54[a]	-	-	-	-
R^2	0.361		0.077		0.158	
Adjusted R^2	0.330		0.033		0.119	
F-statistic	11.565		1.758		3.985	
P value of F-statistic	0.000		0.008		0.000	

"a", "b" and "c" :indicate significance, at the 10%, 5% and 1% level of risk, respectively.

Table 4

Simulation of the cost of capital between the investor and the entrepreneur

For the simulation of the cost of capital of a diversified investor and entrepreneur non-diversified, we are led to set the values of certain variables. The annualized standard deviation of the market is assumed to be 5 %, the annualized risk-free rate is assumed to be 4%, and the market return is assumed to be 10%. Industry-specific standard deviations and correlations with the market are representative of 1997-2007 (based on Table 2). Beta and costs of capital are computed. Reported standard deviations are based on CAPM equilibrium for a well-diversified investor. The entrepreneur's cost of capital depends on the proportion of wealth invested in the venture. The table illustrates full commitment (100%) and partial commitments of 35, 25 and 15%. Entrepreneur's cost of capital is based on equations (9) and (10) and assumes a two-year commitment.

Category	Adjusted Betas	Correlation	Standard Deviation	Cost of capital (%)				
				Well-diversified Investor	Entrepreneur			
					100%	35%	25%	15%
All	0.67	0.15	0.93	14.3	66.6	44.8	37.7	28.9
Industry								
Biotechnology	0.79	0.21	0.81	15.4	54.7	37.2	32.3	25.9
Business/Finance	0.51	0.12	0.88	12.8	62.6	42.5	34.3	26.0
Communication	1.19	0.23	1.09	19.1	78.0	56.5	47.9	37.8
Computer equipment	0.51	0.09	1.14	12.8	91.6	65.1	49.3	35.7
Computer Software	0.68	0.15	0.95	14.3	68.0	46.7	38.5	29.5
Health care	049	0.13	0.82	12.6	57.1	36.4	31.2	24.0
Industry / Energy	0.57	0.15	0.82	13.4	57.4	37.0	32.0	24.8
Retailers and media	0.66	0.14	0.99	14.2	72.0	49.3	405	30.7
Semi-conductors	0.88	0.24	0.79	16.2	52.7	36.4	32.0	26.1
Age								
Year of IPO	0.77	0.18	0.91	15.2	64.6	44.0	37.4	29.1
One Year after IPO	0.63	0.14	0.94	13.9	67.6	45.2	37.9	28.9

VII. CONCLUSION

This paper develops a framework for the evaluation of VC investments. It is based on the application of CAPM to determine well-diversified investors' opportunity cost of capital, such as limited partners of VC firms (LP), and recognizing that under diversified entrepreneurs have higher significant cost of capital than the required rates of well-diversified investors.

We have carried out a study on the parameters that determine the under diversified entrepreneurs' cost of capital and the well-diversified investors' cost of capital. We have basically dealt with data related to new VC IPOs on the French market between 1997 and 2007. We have identified the fact that French VC firms illustrate an average total risk which is three times higher than the market risk. We also demonstrate that the average correlation between VC returns and market return is 0.01. Moreover, we have estimated an average beta risk for the total sample of the VC firms in terms of the SBF 250 market index in a year to be 0.5. Our results, actually, complete the recent studies' conclusions on how we can determine the limits of aversion to the entrepreneur's risk. Our study is different from previous researches that are listed in the financial theory because it is based on a sample of French VC firms and new IPOS. In addition, our choice of the selected period introducing the 2000 stock market crash presents an unprecedentedly tackled problematic.

We have proven that the cost of capital required by the entrepreneur decreases with the decline of the fraction of wealth that was invested in the VC. However, even with a reduced under diversification, the entrepreneur's cost of capital is markedly higher than that required by a well-diversified investor. The difference of the cost of capital between well-diversified investors and under diversified investors offers a possibility for the latter to conceive of a strategy of value maximization for new VC IPOs. These strategies are founded on the decrease of the total investments, which can lead to creating value and therefore, to lower the cost of capital. Thus, contracting between entrepreneurs and investors may affect the new VC IPOs, particularly, the clauses of risk exchange between investors and revaluations of entrepreneurs' compensation or reducing the preferential treatment of investors.

ENDNOTES

1. If investment in the venture is a non-trivial fraction of the investor's portfolio, our approach for determining the entrepreneur's cost of capital also can be used to infer the effect of illiquidity on the investor's cost of capital, in Smith, Smith, and Kerins (2004).
2. Indeed, we proved that the estimates of beta for a non-diversified investor will be higher. This case will be analyzed later as part of the assessment of capital cost of the undiversified contractor.

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