The performance of listed European innovative firms

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Abstract

The paper examines the performance of European VC backed firms operating in the life science and ICT industries at IPO and in the long run. Empirical evidence shows a lower underpricing for VC backed companies and lower volatility of returns in the first days and first weeks of trading, suggesting the important role of venture capitalists in softening the asymmetries of information at IPO. The differences in performance of VC backed firms tend to disappear in the long run, as confirmed by the analysis performed considering various specification of return and risk, as well as employing a three factor market model approach.

Keywords: venture capital, IPO, VC backed, long run performance, risk adjusted performance measure, Europe

JEL classification: G10, G24

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Introduction

European venture capital has gained increasing interest in the latest years by academics, practitioners and policy makers: its relevance in this area has been growing and firms located in European countries have attracted a substantial share of the investments (Aizenman and Kendall, 2008). Traditionally the literature classifies the IPO as a preferred exit strategy by venture capitalists (VCs) and a stream of studies has investigated the effects of the presence of a venture capitalist on the performance of listed firms, both at IPO and in the long run. Generally VC backed firms are expected to have a lower underpricing, thanks to lower asymmetries of information, and a better performance in the following years if compared to other listed firms, although empirical evidence provides however ambiguous result.

This study aims at evaluating the stock performance of a sample of European firms listed between 2002 and 2007 operating in the life science and ICT industries and the role of venture capital in determining firms performance.

To this end, we analyse underpricing at IPO comparing the performance of VC backed and non VC backed companies, as well as the volatility of returns in the first days of trading. Additionally, we perform a multivariate analysis on the determinant of underpricing, including the use of venture capital, and firm, market and country characteristics.

We further investigate the behaviour of European innovative firms after listing using buy and hold returns and risk adjusted performance measures for the first, first two and first three years of trading to compare the group of VC stocks to that of non VC ones. Finally, we employ the Fama-French three factor market model to evaluate the drivers of long run performance and we find evidence that the traditional factors (i.e. excess market return, size and book to market) determine the post-IPO returns over a three year period, while the presence of a VC at IPO has a limited impact in this case.

This research contributes to the literature in three ways: first, it provides further insight on the underpricing phenomenon and on the behavoiur of European companies in the days following the initial offer; second, it explores the role of VC in determining the performance of European listed companies; and third, risk-adjusted performance indices and a three factor market model approach are used to complement the long-run performance analysis to provide more detailed information on the behaviour of European stocks after the IPO.

The rest of the paper is structured as follows: section 1 discusses the previous contributions provided by the literature; section 2 presents the data and the research methodology; section 3 analyses the results on underpricing and long run performance; the last section concludes.

1. Literature review

Empirical literature commonly finds that firms are underpriced at the time of IPO, meaning that a positive difference between the first day closing price and the price of IPO exists, generating positive performance. In other words, on average the offering price is set below the price that prevails on the first trading day (Ibbotson and Ritter, 1995). This might create large returns not only on the first day but also in the first weeks.

The phenomenon has found several explanations, mostly related to the asymmetry of information that affect the issuers, the investment bankers and the investors (for a review of the theories explaining the underpricing see Ibbotson and Ritter, 1995). The offering price might be set at a lower price in order to compensate for the opaqueness of information related to new listed companies and to induce investors to subscribe the stock issue.

Underpricing is generally found to be lower for VC backed firms because venture capitalists have the ability to limit the asymmetries of information that cause the anomaly (Gompers, 1996; Jain and Kini, 2000)

thanks to their experience (Barry et al., 1990) and superior information on the issuer. Moreover, VCs might retain a relevant portion of stocks after the IPO and continue monitoring the firm, and this behaviour translates into a lower underpricing as VCs signal the quality of the firm by maintaining a stake in the company (Barry et al., 1990) (for a review on venture capital, see Da Rin et al., 2013).

Nevertheless empirical evidence is ambiguous and a number of studies finds that VC backed firms do not outperform non VC backed companies (among others, Brau et al., 2004; Da Silva Rosa et al., 2003).

The level of returns of both VC backed and non VC backed firms might depend on the context (Rosenbusch et al., 2013) or on the timing of the offering (for a review on IPOs see Ritter and Welch, 2002; for a discussion on VC backed firms at the time of bubbles see Coackley et al., 2004 and Coackley et al., 2009).

On the determinants of underpricing, the literature finds that the latter is influenced by several firm specific, market and country specific factors, such as firm age, size at IPO, the presence of bubbles and the economic cycle (for a recent discussion and description of these variables, see Engelen and Essen, 2010).

With reference to the long run performance, the literature claims that VC backed firms should have a superior performance, because of the selection process and the monitoring activities that boost the growth potential of the funded firm. Also VCs reputation plays a major role, with more reputable VCs being more involved in the post-IPO and therefore continuing to influence positively the firm's performance as argued by Krishnan et al. (2009). More recently, Bessler and Seim (2012) find that European VC backed firms have a superior performance compared to non VC backed companies in the main market. More in general, several studies find that VC backed companies exhibit a limited rate of failure (Gompers, 1996; Jain and Kini, 2000).

Brav and Gompers (1997) use the Fama and French model to evaluate the stock returns of groups of VC backed and non VC backed companies and find that differences in performance might be influenced by value weighting of stock portfolios. Besides, da Silva Rosa et al. (2003) employ the Fama-French three factor market model and find that market and size factors are the main determinants of IPO performance on Australian IPOs and, additionally, that VC backed have a similar performance to other firms in the long run.

Other studies show how performance might depend on various supplementary factors, such as firms' specific characteristics. Among these, Alperovych and Hübner (2011) investigate the effects of company, industry and product factors on the performance of Belgian VC backed firms and conclude that firm's maturity, its technological development and the competitive environment all affect its future returns.

2. Sample and methodology

The IPO and post-IPO performance is evaluated on a sample of 581 firms listed on European stock exchanges that operate in the ICT and life science (pharmaceuticals and biotechnologies) industries. The ICT industries comprise firms operating in the IT, software, hardware and related fields.

Share prices are obtained through Datastream, while IPO prices are collected using Zephir, stock exchanges statistics and issue prospectuses.

First, we identify VC backed companies through ThomsonOne. We only select the firms located in Europe operating in ICT or life science that have received venture capital (seed, early stage, expansion or later stage funds) between 1997 and 2007 and have concluded an IPO on a European stock exchange between 2002 and 2007. The sample of VC backed firms is made of 114 companies. We limit our sample to 2007 to exclude possible effects of the financial crisis on the IPO performance.

We then select all the IPOs occurred in the same time frame, limiting the research to firms that operate in the same industries. We check if any of these companies received VC before 1997 and eliminate them. We end up with 467 non VC backed companies.

2.1. Univariate analysis

IPO underpricing is computed using the arithmetic returns between the IPO price and the unadjusted closing price of the first day of trading ($P_{i,1}$). We also compute the underpricing for the first week of trading (wgr).

$$dgr_i = \frac{P_{i,1} - P_{i,IPO}}{P_{i,IPO}}$$

$$wgr_i = \frac{P_{i,6} - P_{i,IPO}}{P_{i,IPO}}$$

Net returns are calculated by deducting the return of the relative market index from dgr_i and wgr_i, to control for market movements.

$$dnet_i = \frac{P_{i,1} - P_{i,IPO}}{P_{i,IPO}} - \frac{P_{m,1} - P_{m,0}}{P_{m,0}}$$

$$wnet_i = \frac{P_{i,6} - P_{i,IPO}}{P_{i,IPO}} - \frac{P_{m,6} - P_{m,0}}{P_{m,0}}$$

Gross and net long run returns are computed using buy and hold returns (BHR) of the adjusted closing prices. We suppose a year has 252 days of trading and therefore compute 1-year, 2-year and 3-year BHR as follows:

$$yr1gr_i = \frac{P_{i,252} - P_{i,1}}{P_{i,1}}$$

$$yr1net_i = \frac{P_{i,252} - P_{i,1}}{P_{i,1}} - \frac{P_{m,252} - P_{m,1}}{P_{m,1}}$$

$$yr2gr_i = \frac{P_{i,504} - P_{i,1}}{P_{i,1}}$$

$$yr2net_i = \frac{P_{i,504} - P_{i,1}}{P_{i,1}} - \frac{P_{m,504} - P_{m,1}}{P_{m,1}}$$

$$yr3gr_i = \frac{P_{i,756} - P_{i,1}}{P_{i,1}}$$

$$yr3net_i = \frac{P_{i,756} - P_{i,1}}{P_{i,1}} - \frac{P_{m,756} - P_{m,1}}{P_{m,1}}$$

We also compute monthly returns starting from the first trading day and ending after 36 months.

To further investigate the behaviour of IPO stocks, risk adjusted performance measures are also used to account for the volatility of returns and the correlation with the market. Sharpe ratio (S_i), Sortino ratio (SO_i) and Treynor ratio (T_i) are computed as follows:

- $S_i = \frac{R_i - r_f}{\sigma_i}$
- $SO_i = \frac{R_i - r_f}{DSR_i}$

- $T_i = \frac{R_i - r_f}{\beta_i}$

Where

- R_i is the return of the firm i
- r_f is the risk free rate of return
- σ_i is the volatility of returns of the firm i, computed as the annualised standard deviation of daily returns
- DSR_i is the downside risk for firm i, computed as $DSR_i = \sqrt{\frac{\sum_{i=1}^{n}[\sum ER_i (if\ ER_i \leq 0)]^2}{n}}$
- β_i is the beta of firm i.

2.2. Multivariate analysis

2.2.1. Underpricing

In this study we implement an OLS regression to evaluate which factors determine underpricing of European innovative firms according to the following equation:

$$Underpricing_i = a_{oi} + a_{1\,i}\,VC_i + a_{2\,i}\,X_i + a_{3\,i}\,Y_i + e_i$$

Where $Underpricing_i$ is the performance of the firm i on the first trading day; a_0 is the constant and a_1, a_2 and a_3 are the coefficients; VC_i is a dummy variable equal to 1 if the firm has received venture capital and 0 otherwise; X_i is a matrix comprising firm's characteristics and Y_i includes country and market characteristics; e_i represents the errors.

Among the variables related to firm characteristics, we define firm age as the years between incorporation and IPO. Firm age is relevant, as asymmetries of information are more likely to affect new firms. Additionally, firms operating in the high tech business might suffer additional asymmetries of information. In the sample all the firms operate in high tech industries, but among the various businesses, the life science might be more exposed to this asymmetry and we therefore include a dummy variable to control for the industry. We also control for the value of the earnings per shares, as firms with higher earnings are expected to have higher growth opportunities and might suffer therefore of a higher underpricing. Size also influences asymmetries of information and we capture this characteristic using the logarithm of total assets reported at the date of the IPO and the logarithm of the relative market value, as well as the offer price. When the latter increases, it can be assumed that there is less uncertainty. At the same time, a low price might be a symptom of low expected demand and therefore this translates into a lower first-day return (Jain and Kini, 1999).

With referenct to firm characteristics, for what this study is concerned with, a special relevance is taken by the presence of a venture capitalist, that we isolate using the dummy VC. If the presence of the venture capitalist is able to soften the asymmetries of information, we expect a lower underpricing for VC backed firms and therefore a negative impact of the dummy on the dependent variable.

Market and country characteristics might also affect underpricing. To investigate country characteristics we include the GDP growth to control for the economic cycle, the World Bank indicator for the strength of legal rights (which is however available only starting from 2004) and the overall country market capitalisation, expressed as a logarithm. To control for the presence of market bubbles, we also include the average return of the 6 months before each IPO on the relative market. In a different specification of the model, the variable *main* is inserted to control for the type of stock exchange: IPOs occurring on the main

market are expected to have a lower underpricing, probably because in general regular markets compared to alternative markets (such as AIM UK) have higher entrance standards and requirements and this contributes to a higher disclosure and lower uncertainty.

Table 1: underpricing determinants

Variable	Definition
$Underpricing_i$	First day gross return
Firm and issue specific determinants	
VC	Dummy variable equal to 1 if the firm is VC backed and 0 otherwise
Life science	Dummy variable if the firm operates in the life science industry and 0 otherwise
Size	The logarithm of total assets at IPO
MV	The logarithm of the market value at IPO
EPS	Earnings per share at IPO as the proxy for profitability
Age	Firm age at IPO, computed as years since the incorporation to the IPO year
IPO price	The logarithm of the IPO price
Country and market specific determinants	
GDP growth	Gross domestic product growth (World Bank)
Legal rights	Strength of legal rights indicator (World Bank)
Market size	The logarithm of total market capitalisation (World Bank)
Momentum	6 month returns of the market index before the IPO date
Main	Dummy equal to 1 if the IPO occurred on the main market and 0 otherwise

2.2.2. Long run performance

We focus on monthly returns for the multivariate analysis of the long run performance and apply a Fama and French (1993) three-factor model to evaluate the determinants of firm performance over three years since the IPO. The regression is performed on monthly returns according to the following model

$$R_{it} = \alpha_{it} + \beta_{it} RM_t + \gamma_{it} SMB_t + \delta_{it} HML_t + \varepsilon_{it}$$

Where R_{it} is the excess return of stock i, computed as the monthly return less the corresponding risk free rate[1].

Alpha is the intercept, indicating the specific risk and extra performance. RM is the monthly return of the market less the corresponding risk free rate. We use the DJ Stoxx Europe 600 for the market index, given that we focus on this geographical area2. SMB is the difference of monthly returns between small companies and large companies that should capture the size effects on returns. In this paper it is obtained using the returns on the DJ Stoxx Europe TMI Small 200 Index for small stocks and the DJ Stoxx Europe TMI Large 200 Index for the large companies. HML is the factor capturing growth opportunities and it is obtained subtracting the returns of low book to market value companies to high book to market listed firms. We use the DJ Stoxx Europe TMI Value Index to proxy high book to market firms and the DJ Stoxx Europe TMI Growth Index to proxy the low book to market stocks.

To the basic model, we add another factor in a different specification. We include the dummy VC, which identifies venture backed companies. We therefore run four regressions: one pooled regression on the basic model, one regression for VC backed companies, one regression for non VC backed firms and another regression on the amended model that includes the VC dummy.

[1] We employ the JP Morgan Cash Europe index 1 month to proxy the risk free rate, as well as the UK T bill 3 month and the EONIA rate.

[2] As robustness check, we employ also the MSCI Europe and results remain unchanged. Results are omitted.

3. Results

3.1. Descriptive statistics

Table 2 presents the descriptive statistics of the sample by country. The majority of the firms in the sample are located in the United Kingdom (around 51%); France follows with 154 firms (26.51%) (Table 2). Most of the firms in the sample are related to IT, software and hardware industries (82.44%) and the remaining 17.56% operate in the pharmaceutical and biotechnology industry (Table 3).

Table 2: number of IPO firms by country

Country	Number	Percentage
Austria	3	0.52%
Belgium	25	4.30%
Denmark	8	1.38%
Finland	2	0.34%
France	154	26.51%
Germany	23	3.96%
Hungary	2	0.34%
Italy	3	0.52%
Poland	35	6.02%
Spain	1	0.17%
Sweden	31	5.34%
United Kingdom	294	50.60%
Total	581	100%
of which		
VC	*114*	*20%*
NVC	*467*	*80%*

Table 3: number of IPO firms by industry

Industry	**full sample**	***%***	VC	*VC (%)*	NVC	*NVC (%)*
pharma/bio	**102**	***17.56%***	44	*38.60%*	58	*12.42%*
IT and related	**479**	***82.44%***	70	*61.40%*	409	*87.58%*
total	**581**	***100%***	114	*100%*	467	*100%*

3.2. IPO underpricing

Descriptive statistics for the first day and first week of trading are presented in Table 4.

The underpricing for the full sample is 9.84% for the first day of trading and 24.78% for the first week of trading. VC backed firms exhibit a lower underpricing, in line with the empirical results by Gompers (1996) and Jain and Kini (2000). The differences of underpricing for VC backed and non VC backed are statistically significant for the first day returns, while the differences in weekly underpricing are positive but not statistically different from zero. Most of the IPOs occurred starting from 2004 (Figure 1) and it can be observed that the average initial return by month appears higher when there is a high number of IPOs (Figure 2), although we do not test for this relationship.

The standard deviation of returns for the first 2, 7 and 17 days of trading is around 4% for the full sample. VC backed IPO firms show a lower volatility of returns in the first days of trading if compared to the other firms in the sample (Table 5) and the difference between the two groups of firms appears statistically

significant for the 7- and 14-day volatility; more in detail, we have to reject the hypothesis that VC backed stocks have a higher volatility when compared to non VC backed ones.

Table 4: underpricing

Average returns	Full sample	non VC	VC	difference	t-stat (p-value)
dgr	9.84%***	10.59%	6.80%	3.79%***	3.00 (0.003)
dnet	9.78%***	10.52%	6.72%	3.82%***	3.02 (0.003)
wgr	24.78%**	28.44%	9.75%	18.70%	1.31 (0.190)
wnet	24.63%**	28.24%	9.86%	18.38%	1.29 (0.198)
*, **, and *** indicate respectively 10%, 5% and 1% significance level					

Table 5: volatility of returns

	Full sample	non VC	VC	Difference (non VC – VC)	t-stat[a] (p-value)	t-stat[b] (p-value)
2-day volatility	4.08%***	4.24%	3.44%	0.8%	1.43 (0.154)	1.43 (0.078)
7-day volatility	4.98%***	5.24%	3.92%	1.32%**	1.98 (0.048)	1.98 (0.024)
14-day volatility	4.34%***	4.52%	3.57%	0.95%*	1.75 (0.079)	1.75 (0.0396)

*, **, and *** indicate respectively 10%, 5% and 1% significance level; [a] is the t-statistics for the bilateral test of hypothesis, where H_0: vol_NVC=vol_VC; [b] is the t-statistics for the unilateral test of hypothesis, where H_0: vol_NVC<vol_VC. The significance of the difference relates to the bilateral tests.

Figure 1: number of IPOs by month (full sample)

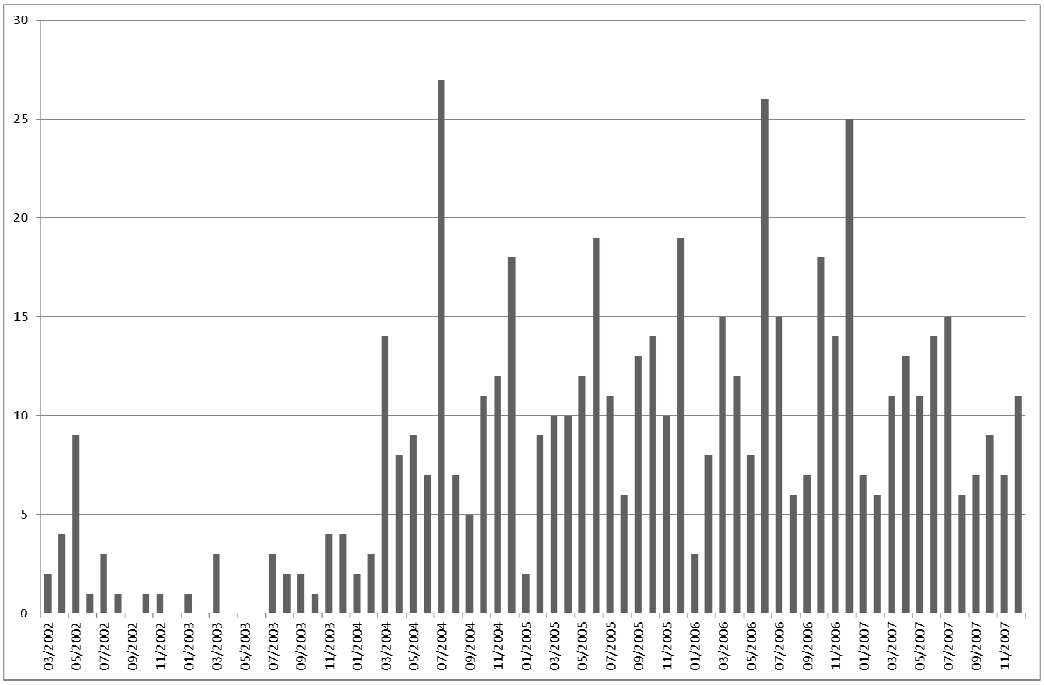
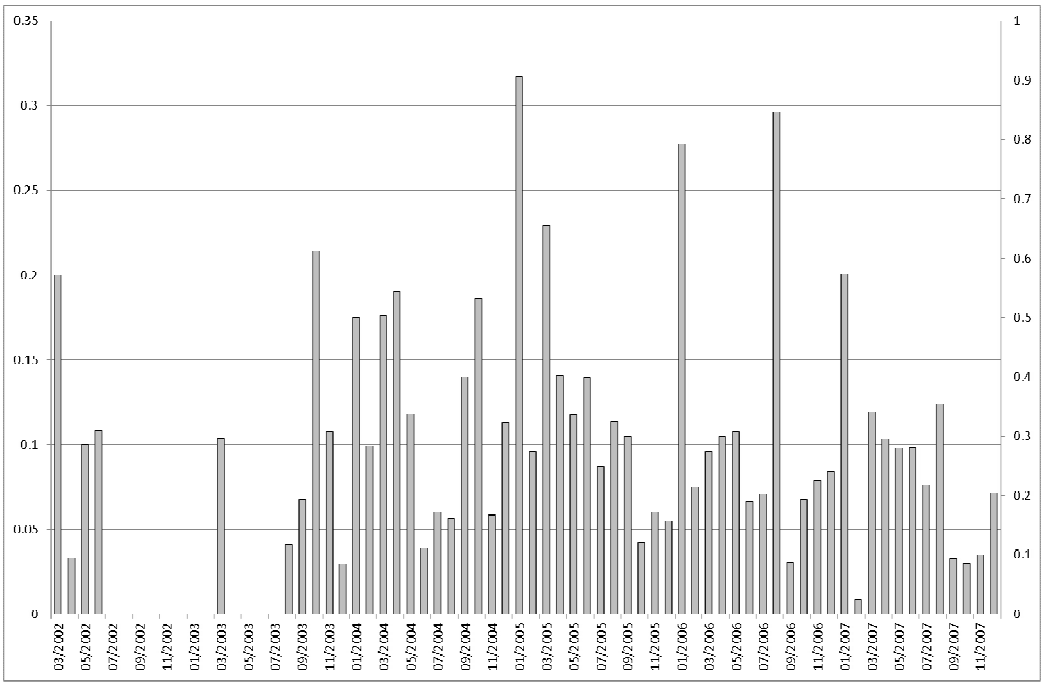


Figure 2: average initial return (dgr) by month (full sample)



3.3. Long run performance

Long run performance is first computed using the buy and hold returns for the first years of trading. For the whole sample, average net returns for the first year and the first two years are positive, while the average cumulated buy and hold returns for 3 years become negative. VC backed firms display always smaller returns than non VC backed firms, however differences are not statistically significant. It seems, therefore that one year after the IPO differences between the two groups are not explained by the presence of a VC investor at the time of the IPO. When computing monthly returns for each month after the IPO we obtain an average monthly return of 3.95% over the whole sample. For VC backed firms the average monthly return is 1.69% while the figure is higher for non VC backed stocks (4.51%), although the difference is not statistically significant.

Table 6: long run performance

	Full sample	non VC	VC	Difference (non VC – VC)	t-stat (p-value)
Buy and hold returns					
yr1gr	8.21%***	8.60%	6.61%	2.00%	0.30 (0.763)
yr1net	3.82%	4.83%	-0.34%	5.17%	0.81 (0.416)
yr2gr	7.83%	11.13%	-5.67%	16.79%	1.33 (0.186)
yr2net	8.62%	12.22%	-6.11%	18.34%	1.49 (0.137)
yr3gr	-8.88%**	-6.98%	-16.63%	9.65%	1.08 (0.283)
yr3net	-1.94%	-0.55%	-7.65%	7.10%	0.79 (0.432)
Monthly returns	3.95%***	4.51%	1.69%	2.82%	1.17 (0.243)

*, **, and *** indicate respectively 10%, 5% and 1% significance level

We also measure the risk for the first years of trading. With reference to volatility of returns, we see that on average VC backed firms have a sensibly lower volatility of returns if compared to other firms. This difference however is statistically different from zero only for the 3-year buy and hold returns (Table 7).

Betas for one, two and three years of buy and hold returns are higher for VC backed firms and this might explain the worse performance of these firms during bear markets (Table 8). Betas are computed using the relative market index.

Table 7: standard deviations of returns

	Full sample	non VC	VC	Difference (non VC – VC)	t-stat (p-value)
dev std_1	17.42	86.75	0.48	-86.26	-1.54 (0.127)
dev std_2	14.34*	70.86	0.54	-70.31	-1.60 (0.113)
dev std_3	12.93*	63.52	0.58	-62.93*	-1.71 (0.09)

Figures in percentages. *, **, and *** indicate respectively 10%, 5% and 1% significance level

Table 8: betas

	Full sample	non VC	VC	Difference (non VC – VC)	t-stat (p-value)
beta_1	0.427	0.397	0.547	-0.150***	-3.51 (0.001)
beta_2	0.429	0.399	0.552	-0.152***	-4.12 (0.000)
beta_3	0.412	0.386	0.523	-0.137***	-3.73 (0.000)

*, **, and *** indicate respectively 10%, 5% and 1% significance level

3.4. Risk adjusted returns

To better understand the dynamics of the performance of the two groups of firms, we now compute risk adjusted long run return on the two groups of firms, supposing to invest in each firm at IPO and hold the stock for one, two and three years. For each firm we compute the Sharpe ratio (Si), the Sortino ratio (SOi) and the Treynor ratio (Ti) for the first year, the first two years and the first three years after the IPO date and we then compare the two groups.

On average, after the first year of trading, the Sharpe, the Sortino and the Treynor ratios take a negative sign for the full sample, suggesting that firms have destroyed value over time on the markets after considering the overall riskiness of returns (computed as the standard deviation of returns) (Table 8) [3].

On the significance, all the Sharpe ratios appear consistently statistically different from zero, as well as two of the Sortino ratios (Sortino_1 and Sortino_3), while the Treynor ratios are not different from zero.

When differentiating between VC backed and non VC backed firms, the do not outperform non VC backed firms in terms of risk adjusted ratio related to the overall volatility, however the difference is significant for two of the Sortino ratios.

Table 9: average risk adjusted performance indexes

	Full sample	non VC	VC	Difference (non VC – VC)	t-stat (p-value)
Sharpe_1	0.141***	0.150	0.105	0.046	0.336 (0.737)
Sharpe_2	-0.135***	-0.116	-0.210	0.094	0.986 (0.325)
Sharpe_3	-0.228***	-0.218	-0.266	0.048	0.695 (0.483)
Sortino_1	0.401***	0.424	0.307	0.117	0.596 (0.552)
Sortino_2	-0.013	0.039	-0.229	0.269**	2.276 (0.023)
Sortino_3	-0.152***	-0.110	-0.327	0.217***	2.853 (0.005)
Treynor_1	0.332	0.387	0.109	0.278	0.106 (0.916)
Treynor_2	-2.660	-3.295	-0.058	-3.237	-0.451 (0.652)
Treynor_3	-1.318	-1.542	-0.396	-1.146	-0.495 (0.621)

*, **, and *** indicate respectively 10%, 5% and 1% significance level

[3] The risk free rate of return proxy in this case is JP Morgan Cash Europe 1 month, but results remain similar using the EONIA rate and the UK 3 Months T-Bill.

3.5. Multivariate analysis

3.5.1. Underpricing

The results for the daily underpricing are reported in Table 10[4]. Results support the hypothesis that venture backed firms have a lower underpricing, as the dummy VC always takes a negative significant sign in the specifications tested, suggesting that venture capital is able to soften the asymmetries of information at IPO.

We control for the issue price, and we see that the variable takes a negative significant value only when including other firm and country specific variables, such as the economic cycle, the size of the IPO firm and the age of the firm at IPO, as well as the type of market in which the firm is listed (main). This result is in line with recent evidence provided by Akyol et al. (2014), but given the low statistical significance in most of the specifications tested, the importance of this variable in this regression should be interpreted with caution. Also the life science dummy is always significant and takes a positive sign, suggesting that life science businesses are more subject to asymmetries of information and higher uncertainty as business outcome is more uncertain and, additionally, their activity can be influenced by changes in regulation and ethical concerns. Age at IPO shows a negative impact on daily underpricing: older firms have a lower underpricing, in line with the theoretical assumption that new firms are more subject to uncertainty. The significance is however limited to specification a.1, while when including other firm specific factors, such as the size, age loses its predictive power.

Evidence highlights that larger firms have a lower underpricing, and the coefficients size IPO and mv IPO take a negative and significant sign in most of the specifications, in line with theoretical predictions. Also the earnings per share are considered but provide no statistical impact on the determination of the underpricing.

The momentum of the market, i.e. the average return of the market index prior to the IPO seems to effectively decrease underpricing, suggesting that during bubbles offer price are closer to investors' expectations, generating a lower first-day returns. The significance of the variable is limited (only in two specification it takes a value statistically different from zero) and as robustness check we also use the 3-month returns before the IPO, but results remain very similar (results are omitted).

Country and market characteristics can also determine underpricing. The rate of GDP growth is considered to take into account the economic cycle and specific year effects. It has a positive significant contribution: during economic booms investors might have excessively positive expectations for new issues and might therefore express a high demand, causing large initial returns. On the contrary, during downturns expectations are likely to be less optimistic and demand is lower and this creates space for lower initial returns. The strength of legal rights has a positive and significant contribution to underpricing, while the overall market capitalisation has a positive but not significant effect on the first day performance.

The variable *main* confirms our expectations on the role of stricter admission requirements, taking a negative sign. IPOs occurring on alternative markets suffer from a higher underpricing, as a probable symptom of lower disclosure and higher uncertainty, as well as a consequence of the type of firms that generally request admission to alternative markets.

To control for year fixed effects, we also include year dummy variables, which however present no statistical significance.

[4] The same model is tested for the first week underpricing and results show how VC is not significant in the determination of underpricing, as already suggested by the test on the average wgr and the only significant variables appear the momentum, the market capitalisation and the dummy main but only in few specifications. Additionally the R2 remains very low and therefore results are omitted from the discussion.

Table 10: regression results for dgr

dgr	a.1	a.2	a.3	a.4	a.5	a.6	a.7	a.8	a.9
vc	-0.055 ***	-0.048 ***	-0.055 ***	-0.057 ***	-0.046 ***	-0.036 **	-0.036 **	-0.028 *	-0.030 *
ln(price)	-0.007	-0.004	-0.004	-0.006	-0.008	-0.016 ***	-0.015 ***	-0.036 ***	-0.036 ***
life science	0.061 ***	0.047 ***	0.048 ***	0.050 ***	0.047 ***	0.053 ***	0.051 ***	0.046 ***	0.047 ***
momentum 6	-0.095	-0.095	-0.101	-0.087	-0.093	-0.082	-0.102	-0.061	-0.058
size IPO		-0.013 ***	-0.017 **	-0.018 **	-0.016 **	-0.014 *	-0.013 *	-0.009	-0.009
mv IPO			0.005	0.005	0.005	0.009	0.009	0.007	0.008
eps IPO		0.000	0.000	0.000				0.000	0.000
age ipo	-0.001 *	0.000	0.000	0.000	-0.001	0.000	0.000	0.001	0.001
GDP growth					0.034 ***	0.037 ***	0.031 ***	0.007	0.006
legal rights								0.036 ***	0.037 ***
market cap									0.000
main						-0.062 ***	-0.063 ***		
year dummies	n	n	n	y	y	y	n	n	n
constant	0.135 ***	0.253 ***	0.280 ***	0.262 ***	0.200 ***	0.207 ***	0.191 ***	-0.043	-0.033
R^2	0.045	0.066	0.075	0.090	0.123	0.155	0.136	0.237	0.237
Adjusted R^2	0.037	0.053	0.060	0.064	0.098	0.130	0.120	0.219	0.218

*, **, and *** indicate respectively 10%, 5% and 1% significance level

3.5.2. Long run performance

Using the Fama and French (1993) three-factor model to investigate long run performance determinants, we obtain the results reported in Table 11. Column 1 shows the pooled regression, where the excess market return, SMB and HML appear to be all determinants. Additionally, the alpha is statistically different from zero and positive, suggesting that the firms in our sample have extra performances.

Column 2 shows the modified version of the main model which includes a dummy variable for VC backed firms. The factor takes a negative although not significant sign and the other factors coefficients remain unchanged. When testing the model separately on the two groups of firms (col. 3 and col. 4), results remain similar, but for HML which loses its statistical significance for VC backed firms. Additionally alpha keeps its positive significant sign, suggesting extra performances of listed innovative firms.

Despite the adjusted R^2 is low, it is in line with previous evidence by de Silva Rosa et al. (2003) and additionally, the Wald statistics confirms that the overall regression significance is high.

When using alternative definitions of free risk, results remain similar, but the coefficient beta for the excess market return becomes insignificant in some specifications and the predictive power of the model is lower (results are reported in the appendix).

Table 11: monthly returns regression results

	1 (pooled)	2 (pooled)	3 (VC)	4 (non VC)
	Coef.	Coef.	Coef.	Coef.
alpha	0.037 ***	0.042 ***	0.013 ***	0.041 ***
market	0.903 ***	0.902 ***	0.483 ***	0.982 ***
smb	1.105 **	1.100 **	1.190 ***	1.103 *
hml	1.204 **	1.198 **	-0.316	1.618 **
VC		-0.025		
R^2	0.33%	0.33%	0.24%	0.33%
Adjusted R^2	0.31%	0.31%	0.23%	0.31%
Wald stat	68.23	69.21	100.66	55.96
Wald p-value	0.000	0.000	0.000	0.000

*, **, and *** indicate respectively 10%, 5% and 1% significance level

Conclusions

This study has evaluated the underpricing at IPO and the long run performance for a sample of European firms operating in innovative industries, namely the life science and ICT businesses.

Results show that a positive and significant underpricing exists for the whole sample, but VC backed companies present a lower underpricing if compared to other firms and a lower volatility of returns in the first days after the IPO. Long run performance is computed for one, two and three years after the IPO using buy and hold gross and net returns and using monthly returns. In general we find a positive and significant performance in the time horizon considered, but results for VC backed and non VC backed firms do not seem to differ substantially when analysing sample means.

The important role of VC in determining underpricing is confirmed by the multivariate analysis, where the dummy for venture backed firms takes a negative and significant value in all the specifications tested. Among the other determinants, the industry has a key role in the first day performance, suggesting that firms more subject to asymmetries of information (such as life science companies) suffer from a higher underpricing. Besides, size impacts on the first day underpricing, as well as macroeconomic conditions and the type of market where the IPO takes place.

The limited role of venture capital financing in the long run stock performance is confirmed when employing a Fama – French multifactor market model to evaluate the monthly returns of VC and non VC backed firms. In general results show that the main determinants driving stock performance are the traditional factor for both groups of stocks: the excess market return, the size effect and the book-to-market factor. Additionally, when using a fourth factor to isolate VC backed firms, returns do not seem to differ between the two types of firms.

Summarising, results in general seem to support the relevant and positive role of venture capital in reducing the asymmetries of information characterising new and highly innovative businesses at IPO, while differences in stock performance after one, two and three years seem to be influenced by other determinants. Further research might clarify if the contribution of venture capitalists remains at operating level or in the growth of sales, productivity or employment of listed firms.

Appendix

Table A1: monthly returns regression results using alternative risk free rates

	1 (pooled)		2 (pooled)		3 (VC)		4 (non VC)	
	Coef.		Coef.		Coef.		Coef.	
UK T Bill 3 months								
alpha	0.035	***	0.040	***	0.011	**	0.040	***
market	0.061		0.060		0.073		0.065	
smb	1.953	***	1.949	***	1.597	***	2.028	***
hml	2.394	***	2.389	***	0.295		2.910	***
VC			-0.025					
R^2	0.21%		0.22%		0.18%		0.22%	
Adjusted R^2	0.20%		0.20%		0.17%		0.20%	
Wald stat	44.21		45.24		73.17		36.32	
Wald p-value	0.000		0.000		0.000		0.000	
EONIA								
alpha	0.036	***	0.041	***	0.012	**	0.041	***
market	0.053		0.052		0.072		0.055	
smb	1.960	***	1.955	***	1.594	***	2.926	***
hml	2.408	***	2.402	***	0.297		2.036	***
VC			-0.025					
R^2	0.21%		0.22%		0.18%		0.22%	
Adjusted R^2	0.20%		0.20%		0.17%		0.20%	
Wald stat	44.16		45.20		72.86		36.30	
Wald p-value	0.000		0.000		0.000		0.000	

*, **, and *** indicate respectively 10%, 5% and 1% significance level

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