Are IPOs of Different VCs Different?

Tereza Tykvová, Uwe Walz

Center for Financial Studies

The *Center for Financial Studies* is a nonprofit research organization, supported by an association of more than 120 banks, insurance companies, industrial corporations and public institutions. Established in 1968 and closely affiliated with the University of Frankfurt, it provides a strong link between the financial community and academia.

The CFS Working Paper Series presents the result of scientific research on selected topics in the field of money, banking and finance. The authors were either participants in the Center´s Research Fellow Program or members of one of the Center´s Research Projects.

If you would like to know more about the *Center for Financial Studies*, please let us know of your interest.

Prof. Dr. Jan Pieter Krahnen   Prof. Volker Wieland, Ph.D.

CFS Working Paper No. 2004/02

Are IPOs of Different VCs Different?

Tereza Tykvová[a], Uwe Walz[b]

29th January 2004

Abstract:
This paper aims to analyze the impact of different types of venture capitalists on the performance of their portfolio firms around and after the IPO. We thereby investigate the hypothesis that different governance structures, objectives and track record of different types of VCs have a significant impact on their respective IPOs. We explore this hypothesis by using a data set embracing all IPOs which occurred on Germany's Neuer Markt. Our main finding is that significant differences among the different VCs exist. Firms backed by independent VCs perform significantly better two years after the IPO compared to all other IPOs and their share prices fluctuate less than those of their counterparts in this period of time. Obviously, independent VCs, which concentrated mainly on growth stocks (low book-to-market ratio) and large firms (high market value), were able to add value by leading to less post-IPO idiosyncratic risk and more return (after controlling for all other effects). On the contrary, firms backed by public VCs (being small and having a high book-to-market ratio) showed relative underperformance.

[a]Address of authors: Tereza Tykvová, Centre for European Economic Research (ZEW), P.O.Box 103443, 68034 Mannheim, Germany, E-mail: tykvova@zew.de;
[b]Uwe Walz, Goethe-University Frankfurt/M., Department of Economics, Schumannstr. 60, 60059 Frankfurt, Germany, E-mail: uwe.walz@wiwi.uni-frankfurt.de

1 Introduction

Venture capital and initial public offerings (IPOs) are closely interrelated. Venture capital crucially relies on the IPO market as an exit channel. It is often argued that without a viable IPO market venture capital can not survive (see e.g. Black/Gilson (1998)). Due to the fact that venture capital is a temporary engagement in the respective portfolio firm,[1] exiting is decisive for the venture capitalist (VC) and the expectation of potential exit possibilities governs the behavior of venture capitalists during the investment phase (see Cumming (2002)). Venture capitalists disinvest their most promising and profitable firms via an IPO.

On the contrary, venture capital serves as an important source for (successful) IPOs. Without promising young firms demanding equity from organized markets, the IPO markets would obviously lack demand. Since VCs are intermediaries specialized in bringing up young (innovative) firms, a functioning venture capital industry serves as an ingredient of the IPO market.

Under these circumstances it is important to understand the role venture capitalists play with respect to the IPO performance (around and after the IPO) of their portfolio firms. There are a number of studies analyzing the impact of venture capital on underpricing and long-run performance. We distinguish our analysis from the existing ones by looking into the differences between different types of VCs. The starting point of our analysis is the observation that VCs differ considerably in their objectives, structure and corporate governance. Our working hypothesis is that these differences have a significant impact on the market performance of the respective portfolio firms. The basic idea behind is that different VCs resolve informational asymmetries and incentive problems to a different degree. A natural playing field for this hypotheses is the German venture capital and IPO market with its wide variety of different types of VCs. Due to the fast growth and institutional background, we find a large variance among venture capital firms being active in the German market.[2] In order to pursue our analysis we hand-collected a data base for all IPOs on the *Neuer Markt* during the period 1997-2002.[3]

---

[1]This can be seen as a mechanism to resolve informational asymmetry and incentive problems between the venture capitalist and its investors (see e.g. Gompers/Lerner (1999b)). It is institutionalized in the fact that venture capital funds are typically organized as closed-end funds.

[2]Independent VCs, bank-dependent VCs, public VCs, corporate VCs, young and experienced VCs, international and national VCs, etc.

[3]*Neuer Markt* was founded in March 1997 and closed in June 2003. However, in 2003 there were no IPOs on this market segment.

Our main results are as follows: We find significant differences among different types of VCs with respect to the post-IPO market performance. It turns out that firms backed by independent VCs perform significantly better than the firms of other VCs or non venture-backed ones. Firms backed by public VCs (a, however, small group of firms) underperform relative to their counterparts. In addition, we find that the shares of firms backed by independent VCs fluctuate significantly less than their counterparts. That is, independent VCs bring about higher (relative) post-IPO returns and less risk. This result is robust to different methodological approaches.

Therefore, it turns out that it is quite useful to split up the group of venture-backed firms, which in other studies has been treated as more or less homogenous. The fact that this was possible to occur (implying that market participants did not anticipate this to happen) can be interpreted as a clear sign for the immaturity of the market. This interpretation, however, leads us to the hypothesis that such abnormalities tend to go away as the market grows older and becomes more mature.

There are a number of studies comparing venture-backed and non venture-backed IPOs addressing the issue of post-IPO performance as well as underpricing. Following Rock (1986), quite a substantial body looks into the impact of venture capital on the degree of underpricing. Studies investigating the effect of venture capital do not come up with a clear-cut picture. In an early study, Megginson/Weiss (1991) stress the certification role of venture capital. They find a negative impact of venture capital on underpricing. Barry et al. (1990) show, by looking at a sample of venture-backed IPOs, that a higher monitoring effort by VCs leads to less underpricing. On the contrary, Ljungqvist (1999) and Smart/Zutter (2003) challenge this view by analyzing US data. Ljungqvist (1999) relates the degree of underpricing to the behavior of old shareholders in general and not to the role of VCs per se. Smart/Zutter (2003) find more underpricing with venture-backed firms than with non venture-backed ones. In a study of the German IPO market (using by and large a very similar data set as ours), Franzke (2001) finds, too, that venture-backed IPOs are more underpriced than non venture-backed IPOs. On the other hand, several studies address post-IPO performance. The message is, however, ambiguous: positive, neutral or negative impact of venture capital financing can be observed. Brav/Gompers (1997) show that in the U.S. from 1975-1992, venture-backed IPOs outperformed non venture-backed IPOs when measured via equal weighted returns. However, this result cannot be confirmed using other methods. Doukas/Gonenc (2001) do not find any impact of venture capital on the long-run performance. Audretsch/Lehmann (2002) analyze the survival of companies on the *Neuer Markt* and

find that the likelihood of firm survival decreases as the ownership share of the group of VCs increases which indicates a negative effect of venture capital.

None of these articles, however, splits up the group of venture capitalists by looking into the effects of different types of VCs. Recently, Rindermann (2003) distinguishes between different types of VCs (public, bank-dependent and independent; national and international) in his analysis of the operating and market performance of IPOs in Germany, France and Great Britain. He uses a different sample (only 1997 - 1999) and different methodologies from those employed in our study. In line with our results, he finds a positive impact of international VCs and a negative influence of public VCs on the stock price performance (using three-year wealth relatives with *NEMAX All Share* Index as benchmark).

The paper is organized as follows. The next section displays a short historical and structural overview of the German venture capital and IPO markets. In this setting our data set is described and some descriptive statistics are given. The third section analyzes the impact of different types of VCs on post-IPO performance and contains the main body of our analysis. There, we address post-IPO returns as well as post-IPO volatility of shares prices. In a first step, we use a cross-section analysis to address the determinants of post-IPO performance in a two-year period. In the second step, a matching approach is used to investigate post-IPO returns. In a final step of the third section we consider the post-IPO idiosyncratic volatility of returns and the influence of different types of VCs on this volatility. The fourth section is devoted to an analysis of underpricing in Germany's *Neuer Markt* by taking the VC's influence, especially of different types of VC, into consideration. The last section concludes.

2 The Structure of the German Venture Capital and IPO Market

Before delving into the details of our analysis, a short overview of the German venture capital and IPO markets will provide some insights which are quite helpful for the future analysis.

2.1 Structure and History

One of the main characteristics of the German venture capital and IPO markets is that the main developments occurred in rather recent times. Before 1990 only a few venture capitalists existed. These few were mainly quasi-public agencies which

were established to promote regional policies (the so-called Mittelständische Beteiligungsgesellschaften). In the period from 1965 to 1985 a number of firms entered the German market, concentrating mainly, however, on later stage investing. As early as in the 1980s an attempt to initiate venture capital in Germany badly failed (see Becker/Hellmann (2000) for details). The experiment initiated in 1975 by the German government with support from the domestic banking industry led the main financial institutions to the conclusion that venture capital and private equity was not part of their (core-) business. The financial system was dominated by the banking industry which gave credit (or not) to young innovative firms. Access to organized capital markets was definitely the exception. Only few firms (mainly established, medium- and large-sized firms) undertook an IPO. In the period between 1970 and 1996 no more than 301 IPOs took place in Germany.

Until the 1990s the venture capital industry in Germany grew rather slowly. This changed quite drastically in the 1990s. The first push came through reunification, leading to the establishment of private equity and venture capital especially in East Germany. These operations were clearly driven by subsidies and dominated by public agencies (the Mittelständische Beteiligungsgesellschaften). The second push occurred after 1995 and was paralleled by the establishment of the *Neuer Markt* in 1997. The growth rates of venture capital activities (either measured by capital invested or by the establishment of venture capital firms) accelerated substantially (see fig. 1).

Starting in 1997 with 11 initial public offerings, the *Neuer Markt* went through an unprecedented growth period. 41 IPOs in 1998 were followed by 130 IPOs in 1999. This number was even overtaken in 2000, the absolute peak of the market with 133 IPOs. But already in the second half of 2000, market conditions deteriorated and market valuations went down making IPOs more and more difficult. This was reflected by the drastic slow-down in the number of IPOs: In 2001 only 11 firms went public. In 2002 it became even more extreme, only a single firm made it on the *Neuer Markt*. This was the last firm with an IPO on the *Neuer Markt*, the brand disappeared after several cases of fraud and a massive reduction in market valuation. A restructuring of the *Frankfurt Stock Exchange* led to a transfer of the firms from the *Neuer Markt* to other market segments.

For a while the *Neuer Markt* seemed to have resolved the exit problem of venture capital firms. Of the 327 *Neuer Markt* IPOs 123 were venture-backed (according to our definition).[4] The boom in the IPO activity was accompanied with a large inflow of capital into the venture capital market. This also led to the creation of many

---

[4]See the next subsection for details.

Figure 1: The yearly growth rates of the gross investments and number of venture capital firms, in %
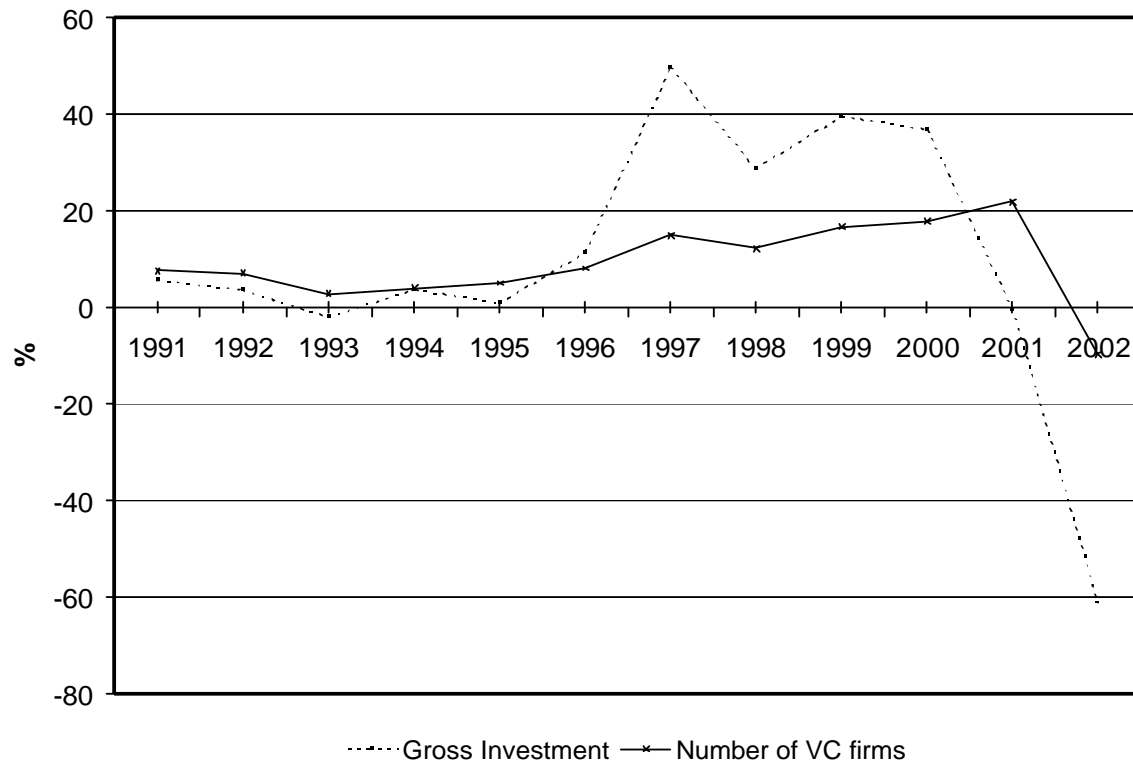
new venture capital firms as well as to the entrance of a considerable number of VCs from abroad into the German venture capital market (either through takeovers of local VCs or via the establishment of local branches in Germany). By and large it is fair to state that the German venture capital industry is quite a young one with not many portfolio managers having an experience in the industry exceeding five years.

For our purpose it is decisive that, due to a number of special influences in the German venture capital market, we observe a wide variety of VC-types and thereby governance structures. First, traditionally and as a result of the overall economic policy, there is a large proportion of venture capital organizations which are basically owned or controlled by the state or public agencies. We will refer to these VCs as public VCs since their main objective is in most cases not the maximization of returns for their investors but rather the promotion of local firms. In any case, their concentration on profit maximization is much less pronounced than with the independent VCs. Second, as a result of the rapid growth of the venture capital market, a considerable proportion of the independent VCs are from abroad, with a quite different governance structure, corporate culture and track record compared

especially to their public and corporate counterparts. This differences are, e.g., also reflected in the design of the contracts with their portfolio firms (see for evidence in this respect Bascha/Walz (2002)) as well as their pre-IPO investment behavior and exit strategies (see Tykvová (2003a)). Third, in the 1990s many players in the banking industry established their own private equity and/or venture capital subsidiaries. The portfolio managers of these VCs act as employees of the mother company rather than partners of an independent VC. There has been some discussion in the literature about the motivation of banks to enter the venture capital market with an own subsidiary (see e.g. Hellmann et al. (2003)). All this makes an investigation of the impact of bank-dependent VCs on their portfolio firms (in the course of an IPO) worthwhile. Finally, we observe several corporate VCs.

In contrast to many other countries, the types of VCs other than the independent ones have a considerable market share in Germany. This is especially true for the public ones. Despite this fact, the proportion of public VCs in our IPO sample is rather small. The main reason for this is that we focus on the lead VCs, whereas public VCs often syndicate with other VCs leaving the leadership with their syndication partner. In addition, public VCs often invest in firms for which other exit strategies than IPO are clearly dominant. That is, the entrepreneurs do not consider the IPO as an interesting exit strategy in the first place and make sure that they are able to pursue other exit strategies (mainly buying back the firm). In addition, due to their specific structure in which profit maximization and the building-up of reputation is not the prevalent target, public VCs are not that interested in IPOs themselves. This is reflected in the actual exit strategies of firms financed by public VCs (see BVK (2002) for the exit behavior of the Mittelständische Beteiligungsgesellschaften[5]).

We use these observations as the main starting point of our analysis, namely to look into the impact of different types of VCs on the performance of firms around and after the IPO. To a certain extent this wide variety of types of venture capital firms is reflected in our sample of venture-backed IPOs. Of the 123 firms financed by venture capital, ten were backed by a public VC, 8 by a corporate VC whereas in 38 cases the lead VC was a bank-dependent VC. The remaining 66 companies were backed by an independent VC. For one firm (VIVA) we cannot ascertain the names of the VCs. In the entire sample we classify 61 cases as backed by a non-German VC, 50 from them being independent VCs, nine bank-dependent VCs and two corporate VCs.

---

[5]52.2 % (199) of the portfolio firms in 2001 were exited via a buy-back, 45.9 % (175 firms) via liquidation and only 1 firm via an IPO.

2.2 The Data Set

Our analysis is based on a unique hand-collected database of IPOs on Germany's *Neuer Markt*. We considered only "real" IPOs. Thus, we excluded firms that were listed on another exchange when going public on the *Neuer Markt*. The data were obtained from several sources. From the *Deutsche Börse AG*, we received the following data: date of the IPO, offer price, first price, issue size, classification of the industry, names of Designated Sponsors[6] and the shareholder structure immediately after the IPO.

The information on the duration of the venture capital financing before the IPO, the firm age and size, the name(s) of the lead underwriter(s), the shareholder structure (prior to and immediately after the IPO) and the book value at the IPO was collected from the listing prospectuses of the companies. Some of these data could have been cross-checked with the information from the *Deutsche Börse AG*.

We considered a firm as venture-backed if at least one of its shareholders was affiliated at a national or an international venture capital association and owned at least five percent of the pre-IPO equity. In its short history, there were 327 IPOs on the *Neuer Markt*. According to our definition, 123 of them were venture-backed.[7] The venture capital firm which held the largest share of the equity prior to the IPO was labelled the lead VC.

The data on venture capitalists (size, affiliation(s), age, type) were brought together from the following sources: the *VentureXpert* database, the directories of the German, European and US venture capital associations (*BVK, EVCA, NVCA*) and Webpages of venture capital firms on the Internet. The rank coefficient was based equally on the size and the age of the lead venture capital firm. We divided the venture-backed firms into four subgroups depending on the institutional affiliation of the lead VC. We distinguished between four types: public, bank- (or insurance-) dependent, independent and corporate VCs. Further, we looked whether or not the headquarter of the lead venture capital firm was in Germany.

The rank of an underwriter depended on his activities as the lead underwriter, namely the number of new issues on the *Neuer Markt* and their volume in the precedent period, and was determined yearly. The rank of a Designated Sponsor was based equally on the number of his mandates on the *Neuer Markt* and on his

---

[6]Each share on the *Neuer Markt* had to have at least two Designated Sponsors. Their main task was to provide liquidity for the trading of this security.

[7]One of the venture-backed firms, VIVA, was removed from the sample since we have no information on the names and the respective shareholdings of the venture capitalists who financed this firm.

rating by the *Deutsche Börse AG* in the preceding period and was set up quarterly. The reputation measures were designed in the following way: The lower the number, the better the rank (thus, 1 indicates the best rank).

The index (*NEMAX All Share*, *DAX 100*) returns and the data on individual stock prices and dividends come from the *Bloomberg* database. A few companies were not found in *Bloomberg*, we used *Thomson Financial Datastream* instead. For two firms, *FOCUS Digital AG* and *RT-SET Real Time Synthesized Entertainment Technology Ltd.*, we did not find data on returns in either database. For seven firms that went public later than March 2001, we have no data on two-year-returns because our time-series on returns end in March 2003. Eight firms left the market within two years.

Table 1 comprises our main variables and their abbreviations. All financial data before 1999 were converted into Euros.

Table 1: List of variables used

MARKET

HOTISSUE[*]	One, if the firm went public during the hot issue period, zero otherwise
MARKET2Y	2-year post-IPO *NEMAX All Share* buy-and-hold return
RECENT	Underpricing of the five preceding new issues on the *Neuer Markt*

FIRM

MV	Market value at the IPO (Mil. Euro)
BTM	Book-to-market ($*10^{-6}$)
AGE	Firm age at the IPO (in days)
RETURN2Y	2-year post-IPO buy-and-hold return
ABNORMAL2Y	RETURN2Y - MARKET2Y
UNDERPRICING	(First price - offer price) / offer price
SIZE	Issue size (based on the offer price, in Euro)

VENTURE CAPITALIST(S)

VC	One, if the firm is venture-backed, zero otherwise
PUBLIC	One, if the lead VC is public, zero otherwise
BANK	One, if the lead VC is a financial service / banking / insurance company or their subsidiary, zero otherwise
CORP	One, if the lead VC is a corporate VC, zero otherwise
INDEP	One, if the lead VC is an independent venture capital firm, zero otherwise
GERM	One, if the lead VC is German, zero otherwise
PREIPOLENGTH	Duration of the pre-IPO venture capital equity financing (in days)
RANK	Rank of the lead VC, depending on its age and size; range: 1 (highest rank) - 5 (lowest rank)
LOCK	Extent of the lock-up by the group of venture capitalists (% of their old shares retained beyond the IPO)

OTHER MARKET PARTICIPANTS

DSRANK	Rank of the Designated Sponsors (average), depending on their rating and the number of companies they manage; range: 1 (highest rank) - 10 (lowest rank)
UNDRANK	Rank of the lead underwriter (if more lead underwriters: the average of their rank), depending on the number of issues and their volumes; range: 1 (highest rank) - 10 (lowest rank)

[*]The time horizon between March 1, 1999 and November 30, 2000 was labelled the hot issue period.

8

2.3 Some Descriptive Statistics

IPOs on Germany's *Neuer Markt* took place in a setting of pronounced volatility in shares prices. The market development can be split into three parts (see table 2). In the first one, the beginning phase, share prices moved steadily upward. The second one, a hot issue period of 1999 and 2000 combines exploding share prices with a large number of IPOs (see table 3).[8] The last period is characterized by a rapid decline in share prices associated with a deterioration of the IPO-activity and a large number of company scandals, which lead finally to the closing-down of the *Neuer Markt* in June 2003.

Table 2: Market development (1997-2003)

This table displays the broad market development by reporting the level of the *NEMAX All Share* Index at the end of each quarter.

Q/Year	03/97	06/97	09/97	12/97	03/98	06/98	09/98	12/98	03/99	06/99	09/99	12/99	03/00
Nemax	606	786	942	1000	2182	2333	2110	2745	3242	3412	2680	4572	6629

Q/Year	06/00	09/00	12/00	03/01	06/01	09/01	12/01	03/02	06/02	09/02	12/02	03/03	06/03
Nemax	5369	4875	2743	1684	1503	843	1095	1029	664	389	405	385	517

IPOs were rather heavily concentrated in 1999 and 2000. For our purpose it is important to note that, in the main part, the different types of VCs do not show special concentration of their IPOs in one particular period or year, thereby not deviating from the overall trend.

In order to give a first impression of the characteristics of the IPOs of the different types of VCs, table 4 displays the main variables and relates them to the different types of VCs. The IPOs differ widely in size in our sample. Small issues have to be compared with a few real "heavy-weights" with a market value of a couple of billion Euros (up to 43 billion Euros). Bank-dependent and public VCs were engaged in significantly smaller issues (SIZE) from firms with a lower market value (MV).

With respect to book-to-market ratios (BTM) we face a number of firms having negative book-to-market ratios. Since there are no objections against using these observations we left them in the sample. Bank-dependent VCs show significantly higher book-to-market ratios than their counterparts on average. On the contrary, independent VCs concentrated mainly on growth stocks.

---

[8]Table 3 includes an additional (venture-backed) firm, VIVA, which went public on the *Neuer Markt*. Since we do not have any information on the lead VC (and its type) we excluded it from our data sample and, thus, are not able to give any information about the type of the VC in this table.

Table 3: IPOs on Germany's *Neuer Markt* over time

This table depicts the number of IPOs on the *Neuer Markt*, sorted by year and type of VC.

Year	1997	1998	1999	2000	2001	2002	$\sum$
No. of IPOs	11	41	130	133	11	1	327
VC	7	15	45	53	3	0	123
INDEP	2	7	25	30	2	0	66
BANK	4	8	12	14	0	0	38
CORP	0	0	2	6	0	0	8
PUBLIC	1	0	6	2	1	0	10

The two-year abnormal returns (ABNORMAL2Y) vary widely as well. Since we consider the difference between individual returns and the market return (*NEMAX All Share* Index), timing issues are potentially eliminated. The remarkable differences in average abnormal returns among venture-backed and non venture-backed IPOs as well as for firms backed by independent VCs which turn out to be significant, already indicate that there are strong differences which might also show up when controlling for other factors of influence.

The UNDERPRICING variable displays mostly positive levels in some cases at exorbitant levels. The univariate t-test, however, does not detect any significant differences among the groups with the exception of corporate VCs which exhibit a lower degree of underpricing for their portfolio firms on average.

Our subsample of venture-backed firms contains quite different types of venture capital financing arrangements. Obviously, some just represent bridge financing with a rather short period of engagement (represented by the PREIPOLENGTH variable) of the VC in the portfolio firm. Especially bank-dependent and public VCs have on average a rather short holding period. Thus, they often are simply not able to fulfill the task of an active investor and monitor due to their short holding period. The reverse is true for the independent VCs who have a significantly longer duration of the pre-IPO financing period on average.

Overall table 4 reveals a rather pronounced variations of the different variables among the firms backed by different types of VCs.

Table 4: Realizations of main variables for different types of VCs

This table contains some descriptive statistics of our main variables as well as tests on the equality of means and medians of the variables for the respective groups and the rest. Before employing a t-test for the respective means we test for equal variances. If the null-hypothesis of equal variances is rejected at the 5 % significance level, we use a t-test with unequal variances otherwise we use a t-test with equal variances (in italics). Additionally, a nonparametric two-sample test on the equality of medians with the test chi-squared statistic without a continuity correction is employed and its p-value is reported.

The sample includes all venture-backed and non venture-backed IPOs in the 1997-2002 period on the *Neuer Markt*, Frankfurt. We excluded VIVA (all variables) and EM.TV (ABNORMAL2Y).

One, two and three asterisks point to significance at the 10 %, 5 % and 1 % level. An asterisk in brackets indicates significance at the 15 percent level.

Variable	Subsample	Observations	Mean	Minimum	Maximum	p-value (mean)	p-value (median)
MV	NON-VC	204	561.8	26.0	42867.0		
	VC	122	251.9	29.0	1716.7	0.150(*)	0.492
	INDEP	66	303.6	45.6	1716.7	0.300	0.270
	BANK	38	183.5	60.1	632.9	0.053*	0.038**
	CORP	8	285.5	68.0	996.3	0.345	0.152
	PUBLIC	10	142.8	29.0	555.0	0.034**	0.054*
BTM	NON-VC	204	26611	-272002	242827		
	VC	122	27292	-63831	131664	0.866	0.252
	INDEP	66	20681	-63831	102144	0.090*	0.168
	BANK	38	38659	-15466	131664	*0.041**	0.016**
	CORP	8	20681	5278	31455	0.117(*)	0.474
	PUBLIC	10	33016	-12973	115958	*0.602*	0.199
ABNORMAL2Y	NON-VC	190	-0.092	-3.009	5.245		
	VC	118	0.290	-4.215	18.389	0.100*	0.348
	INDEP	63	0.536	-2.017	18.389	0.099*	0.323
	BANK	38	0.143	-3.989	8.803	0.779	1.000
	CORP	8	0.015	-0.194	0.212	0.713	0.474
	PUBLIC	9	-0.569	-4.215	0.495	*0.251*	0.735
UNDERPRICING	NON-VC	204	0.473	-0.250	4.333		
	VC	122	0.510	-0.118	3.400	*0.649*	0.492
	INDEP	66	0.506	-0.118	2.231	0.786	0.270
	BANK	38	0.534	-0.077	3.400	*0.668*	0.730
	CORP	8	0.255	0.000	1.000	0.091*	1.000
	PUBLIC	10	0.653	0.000	2.061	*0.459*	1.000
PREIPOLENGTH	VC	106	602	13	2990		
	INDEP	61	711	13	2412	*0.020**	0.031**
	BANK	31	410	22	2990	*0.024**	0.019**
	CORP	7	806	75	1726	*0.325*	0.241
	PUBLIC	7	300	37	891	*0.144(*)*	0.241
SIZE ($*10^6$)	NON-VC	203	83	8	3080		
	VC	121	58	10	302	0.148(*)	0.206
	INDEP	65	68	14	302	0.612	0.018**
	BANK	38	44	11	197	0.014**	0.167
	CORP	8	86	41	219	0.615	0.004***
	PUBLIC	10	25	10	58	0.000***	0.054*

3 Post-IPO Performance

3.1 Background

Starting with the analysis of Ritter (1991) and Loughran/Ritter (1995) the post-IPO performance of firms has attracted a lot of attention. Since then, a number of papers have challenged the initial findings by proposing different empirical techniques without really being able to fully explain the underperformance puzzle (see e.g. Barber/Lyon (1997), Lyon et al. (1999), and Kothari/Warner (1997)).

Brav/Gompers (1997) were the first who investigated the role of VCs in the long-run market performance of IPOs. They show that the underperformance documented in the initial studies comes mainly from small, non venture-backed IPOs. Thus, within the group of small companies, venture-backed firms are better prepared to perform well in the aftermath of the IPO.

Venture capitalists, however, differ to a large extent and do represent a quite dispers group of financial intermediaries. Depending on their main investor(s), we observe a wide heterogeneity of corporate governance as well as objectives and in particular experience among VCs. This heterogeneity exists in most countries and is especially pronounced in the continental European economies, particularly in Germany. The existence of a large public sector and an interventionist culture led to the establishment of a considerable number of public VCs. Given the country's bank-dominated financial system it is not too surprising that commercial banks have created their own venture capital funds which played an important role in the German venture capital market in the last couple of years. Finally, corporate venture capitalists exist in Germany. They are mainly subsidiaries of their (industrial) mother companies and therefore often possess a different legal and economic structure compared to their independent counterparts.

In the following we will analyze the hypothesis that the different objectives of the different types of VCs (see on this e.g. Hellmann et al. (2003) and Gompers/Lerner (2000)), the diversity of these VCs' corporate governance (see Cumming (2000)) and experience (see Tykvová (2003b)) will have a significant impact on the post-IPO performance of the firms they have brought public.

We do this in two steps. In the first one, we investigate the post-IPO returns and ask, among other things, whether there are significant differences between different types of VCs. In a second step, we look into the effect of VCs on IPO prices and after-IPO price fluctuations from a different angle. We analyze the pricing precision of venture-backed firms by looking at the post-IPO idiosyncratic volatility of returns on firms backed by different VCs. Thereby we take up an argument made

by Neus/Walz (2003), on the basis of a theoretical analysis of the exit choices of VCs, that experienced VCs are able to price their portfolio more precisely leading to less volatility in the post-IPO market. Their arguments basically rest on the fact that experienced VCs can use the reputation they have acquired as repeated players in the IPO market to signal the quality of their firms. Thus, they are able to exit at the "true" prices leading to less underpricing and less after-IPO volatility of returns.

In order to pursue our first step we employ various techniques. First, we undertake a cross-section analysis of post-IPO returns. Second, we employ a matching procedure with the purpose of comparing (abnormal) returns on similar firms.

Due to our data set and the specific situation of the German venture capital market we concentrate on a two-year time span after the IPO. Since the bulk of all IPOs took place in 2000, a longer time period would exclude a large number of IPOs. In contrast, a shorter time span stands in contrast to our goal to investigate long-run performance of shares in the post-IPO period. Thereby, due to the specific constraints of our data set, we deviate from the convention of researchers using US data to look at three or even five year returns (see e.g. Ritter (1991) and Brav/Gompers (1997)).

3.2   Methodological Issues

A growing research analyzes the methodology of performance measurement and addresses the questions how risk and return should be quantified appropriately and how well-specified test statistics should be designed. Ritter/Welch (2002) argue that many of the phenomena found in the IPO literature depend upon the time period examined. Most authors agree that the result of the performance measurement is always conditional on the underlying model (e.g. Brav/Gompers (1997) and Gompers/Lerner (2003)) and the statistical tests (e.g. Barber/Lyon (1997), Lyon et al. (1999) or Kothari/Warner (1997)) used. Therefore, we use several methods to check whether the differences between the different types of VCs are robust. In the following, the main findings from the recent literature will be summarized and reasons for approaches used in this paper will be given.

The early research on the post-IPO stock performance on the U.S. market (and almost all studies for Germany) compares returns on newly listed firms to returns on market-wide indices. The basic shortcoming of this approach is that it implies for all firms the same average systematic risk (beta equal to one) that is constant over time. A lot of studies that use this methodology exist for German data, analyzing the performance of IPOs before the *Neuer Markt* was introduced. Two examples of English-written studies are Ljungqvist (1997) and Bessler/Thies (2002).

13

More sophisticated methods that control for risk have been developed and used (for U.S. data). Beginning with Ritter (1991), various matching approaches have been introduced, matching sample firms to either single control firms (matching one-to-one) or to portfolios. In the earlier studies, firms have been matched on size (Loughran/Ritter (1995)) or size and industry (Ritter (1991)), in later studies on size and book-to-market (Brav/Gompers (1997) or Brav et al. (2000)). Barber/Lyon (1997) have shown that matching on a one-to-one-basis is the most adequate benchmark concept. It does not suffer from the rebalancing and the skewness bias (as do methods using equally weighted portfolios) since both the sample and control firm returns are calculated without rebalancing and without averaging. Our one-to-one matching approach in section 3.4 eliminates as well the new listing bias since both the sample and control firm are listed at "nearly" the same time. We use different approaches to match firms to control firms. In each of these approaches, sample firms are matched to a control firm on the basis of specified firm characteristics (market value of equity and book-to-market ratio at the IPO) and the IPO timing. However, matching one-to-one induces the noise of selecting potential outliers, particularly if samples are small. Thus, additionally, we match firms to portfolios instead of single firms and obtain similar results.

Alternatively to matching, time-series three-factor models designed by Fama/ French (1993) are commonly used to analyze the post-IPO performance (e.g. Brav/ Gompers (1997) and Brav et al. (2000)). Hereby, portfolio returns are regressed on the market (beta) factor, size and book-to-market effects. Some studies consider additional factors, e.g. leverage and liquidity (see Eckbo/Norli (2000)) or the previous return (see Brav et al. (2000)). Due to a short horizon and lack of data on factors for Germany we do not perform factor model analysis. Instead, in section 3.3 we employ a cross-section analysis similar to Ritter (1991). We regress firm returns on the market return, various control variables (size, book-to-market, age, industry dummies) and types of VCs.

In most of the analyses in the paper, we exclude firms that left the market during the period under consideration. We address the issue of the potential survivor bias in section 3.4 where we include the (eight) firms which left the market on the basis of their 1-year return. The results did not change very much compared to the matching without these firms.

Last but not least, the studies on performance often suffer from bad test statistics. However, using matching one-to-one as in section 3.4, the test statistics are well specified (see Barber/Lyon (1997)). We address this problem in section 3.3 as well. We assume heteroscedasticity and employ corrected t-test statistics.

Post-IPO returns in this paper are measured as buy-and-hold (abnormal) returns. Dividends are included. The window over which the post-IPO buy-and-hold returns are recorded is two years. In section 3.4, we calculate the differences between the VC-types based on both, the buy-and-hold returns and the wealth relatives. However, no considerable differences can be detected.

3.3   Cross-Section Analysis of Returns

In a first step, we explore the determinants of the post-IPO returns in a cross-section analysis. We define performance (r_t) as:

$$r_t = \frac{P_{t+1} + D_{t+1} - P_t}{P_t} \quad ,$$

with P_t (P_{t+1}) being the share price at the IPO (two years after the IPO) and, additionally, the dividends during the two-year period (D_{t+1}) are taken into account. Our ultimate goal is to look into potential effects of different types of VCs on the returns on their portfolio firms. In order to isolate these effects we include various variables which control e.g. for size, age, and industry (9 industry dummies) of the particular firm. We use the market value of the firms at the time of the IPO as proxy for firm size. The book-to-market ratio (at the time of the IPO) serves as an indicator for the market expectation of future growth potentials. Market return (measured as the two-year return on the *NEMAX All Share* Index) in the corresponding period takes market developments into account.

We exclude one particular outlier, EM.TV, from all our calculations. This firm shows impressive returns in the two-year post-IPO period, but little later it turns out to be one of the most widely-discussed cases of fraud in the *Neuer Markt*. Since EM.TV extremely outperforms all other firms, it would clearly dominate the estimations. In order to exclude this particular influence we decided to eliminate EM.TV from our sample.

Table 5 delineates our results. We estimated six models which differ with respect to sample size as well as variables included. The basic model (Model I) embraces the entire sample and includes, besides the main control variables, the dummy variables depicting the different types of VCs. The baseline model already reveals the main pattern, which turns out to be rather robust throughout the various specifications. We find in Model I a significant positive effect of INDEP on two-year returns. That is, firms backed by independent VCs performed significantly (at the ten percent level) better than their counterparts which were either backed by other VCs or not venture-backed at all. We find negative, but insignificant coefficients for the PUBLIC and CORP variable. Our data also indicate that firms backed by bank-dependent

Table 5: Cross-section regressions of two-year post-IPO returns

This table reports the results of different cross-section OLS regressions of two-year post-IPO returns.

The sample includes all venture-backed and all non venture-backed IPOs in the 1997-2002 period on the *Neuer Markt*, Frankfurt. We excluded two firms, VIVA and EM.TV.

t-statistics (corrected for heteroscedasticity using Huber-White-sandwich estimator) are in parentheses. Industry dummies are used as control variables, but not reported in the table. The coefficient of the constant used in the estimations is left out as well.

One, two and three asterisks indicate significance at the 10 %, 5 % and 1 % level. An asterisk in brackets points to significance at the 15 percent level.

	I: Full Sample	II: Full Sample and national origin	III: Full Sample and other market participants	IV: Full Sample and hotissue	V: VC-Sample	VI: VC-Sample and national origin
MV $(*10^{-6})$	2.4 (0.26)	1.8 (0.19)	1.7 (0.20)	2.3 (0.26)	-1911.9 $(-1.94)*$	-2072.5 $(-2.02)**$
BTM $(*10^{-6})$	1.1 (0.65)	0.8 (0.46)	0.9 (0.55)	0.6 (0.36)	10.3 $(1.53)(*)$	8.4 (1.26)
MARKET2Y	1.1 $(2.76)***$	1.1 $(2.77)***$	1.1 $(2.52)**$	1.5 $(1.90)*$	1.6 $(2.92)***$	1.6 $(2.94)***$
AGE $(*10^{-6})$	-6.3 (-0.22)	-7.1 (-0.25)	-18.0 (-0.66)	2.5 (0.10)	-6.2 (-0.15)	-4.6 (-0.11)
BANK	0.2 (0.44)	0.6 $(2.01)**$	0.5 $(1.72)*$	0.5 (1.41)	0.4 (0.47)	-0.3 (-0.44)
CORP	-0.01 (-0.03)	0.4 (1.11)	0.5 $(1.64)(*)$	0.3 (0.97)	0.8 (1.14)	
INDEP	0.6 $(1.73)*$	0.7 $(1.84)*$	0.7 $(1.79)*$	0.8 $(1.90)*$	1.4 $(1.68)*$	0.2 (0.60)
PUBLIC	-0.5 (-0.98)	0.1 (0.26)	0.3 (0.57)	0.04 (0.07)		-0.6 (-0.78)
GERM		-0.6 $(-1.92)*$	-0.7 $(-2.38)**$	-0.5 $(-1.76)*$		-0.7 $(-1.92)*$
DSRANK			0.03 (0.45)			
UNDRANK			-0.02 (-0.78)			
HOTISSUE				1.3 (0.90)		
# of obs.	308	308	307	308	118	118
R^2	0.35	0.35	0.36	0.37	0.48	0.49

VCs tend to perform relatively better than all other firms. This effect is, however, not significant at a ten percent level. With respect to the control variables we find a strong and highly significant positive impact of market returns. The remaining control variables are insignificant.

In a further step (Model II) we also included a variable measuring the national decent of the VC. This variable (GERM) indicates that firms backed by non-German VCs do outperform the others. This might be explained by the longer track-record of international VCs, an influence which is underestimated by the capital markets.

The inclusion of other market participants (namely the designated sponsors and the lead underwriter(s)) does not really change the above picture (see Model III). The inclusion of these two variables leads to a stronger significance of GERM. Adding the HOTISSUE variable (Model IV) does not change the picture. The positive sign of INDEP remains significant.

If we consider only our VC-sample and thereby compare the different types of VCs with each other, the overall picture is not altered. Firms being backed by independent VCs outperform firms which have been financed by other VCs (see Model V). If we take GERM in the VC-sample into account, most of the effect of INDEP is picked up by this variable (see Model VI).

The overall picture is, however, quite clear-cut. There are significant differences between the two-year performance of firms backed by different VCs and non venture-backed IPOs. In the group of the venture-backed firms we find a consistent pattern. Firms financed through independent VCs did significantly better (or given the overall market trend in our period of investigation not worse) than the other firms in the *Neuer Markt*. The BANK variable is typically positive but in most cases not significant. If we take the national origin of the VCs into account we find that firms backed by international VCs tend to perform significantly better than others. Obviously, this effect, which should result from the experience of international VCs as monitors, is not discounted by the market participants reflecting potential inefficiencies of a young capital market.

3.4   Matching Returns 'One-To-One'

In the next step, we match firms on one-to-one basis using eight different approaches. In order to deal with the differences between venture and non venture-backed companies and among different types of VCs, we divide the sample into six groups (VC, NON-VC, PUBL, BANK, INDEP and CORP). For each firm from a certain group (e.g. PUBL), we choose a control firm from another group (e.g. NON-VC). The differences among the matching methods used can be found in the (a) period in which

17

the (abnormal) returns are measured and (b) restrictions posed on the group of potential matching firms. For each approach, the most similar firms are put together and their return differences are analyzed. The "similarity" is measured in terms of size, book-to-market ratio and the IPO timing. We always use two-year buy-and-hold returns (BHR). The results are depicted in table 6. The superior performance of venture-backed firms, particularly of the group financed by independent VCs, has been confirmed. Moreover, firms backed by a public VC perform significantly worse than companies from other groups.

We use two different observation periods. In (1) - (4), we follow each issuing firm over two years from its IPO date. We compare the abnormal return (= firm return minus *NEMAX All Share* return) on the sample and the control firm:

$$\text{ABNORMAL}_i - \text{ABNORMAL}_c.$$

Hereby, the periods in which returns on the firm i and c are measured may slightly differ because of different IPO dates. However, the inclusion of the market return should control for this effect.

In (5) - (8), the measurement period is the same for both, the sample and the control firm. It starts three weeks after the IPO of the firm with the later IPO (time t) and lasts for two years (time $t + 2$).[9] We compare the return on the sample and the control firm:

$$(\text{BHR between } t \text{ and } t + 2)_i - (\text{BHR between } t \text{ and } t + 2)_c.$$

To check whether the disparities are robust over different control firms' samples, we use varying restrictions on the group of matching firms. In (1) and (5), we match venture-backed firms only to venture-backed firms financed by a different type of venture capitalist. Thus, a firm backed e.g. by a public VC may be matched with a firm backed by a corporate, bank-dependent or independent VC. Using this approach, the differences between different types of VCs are focused on. In (2) and (6), we compare firms backed by different types of VCs to non venture-backed firms. Thus, each venture-backed firm is matched to the most similar non venture-backed firm. In (3) and (7), the group of potential matching firms includes all firms with the exception of firms backed by the same type of VC as the sample firm. Thus, a firm backed e.g. by a public VC may be matched to a firm backed by a corporate, bank-dependent or independent VC or to a non venture-backed firm. In (4) and (8), the group of matching firms is restricted for the non venture-backed sample firms

---

[9]The reason for not starting at the date of the later IPO is the high volatility immediately after the listing.

Table 6: Matching one-to-one, average return differences; sample vs. control firm

This table reports the means of the difference in two-year buy-and-hold returns between a sample firm i and a control firm c for venture-backed firms (VC), non venture-backed firms (NON-VC) and firms backed by different types of VCs (PUBLIC, BANK, INDEP, CORP).

The sample includes all venture-backed and all non venture-backed IPOs in the 1997-2002 period on the *Neuer Markt*, Frankfurt. We excluded two firms, VIVA and EM.TV.

For (1) to (4): $\text{ABNORMAL}_i - \text{ABNORMAL}_c$.

For (5) to (8): (buy-and-hold return between t and $t+2)_i -$ (buy-and-hold return between t and $t+2)_c$.

Standard deviations are in parentheses. Number of observations is in italics.

"**+**" indicates that the difference in means of the matched returns between a certain group (VC, NON-VC, PUBL, etc.) and the rest is significant (a standard two-sided t-test allowing for unequal variances)

"*****" indicates that the difference in medians of the matched returns between a certain group (VC, NON-VC, PUBL, etc.) and the rest is significant (a nonparametric two-sample test on the equality of medians with the test chi-squared statistic without a continuity correction)

"**†**" indicates that the average return difference between a sample and a control firm in a certain group is significantly different from 0 (a standard two-sided t-test)

+++, ***, ††† indicate significance at the 1 % level; ++, **, †† indicate significance at the 5 % level; +, *, † indicate significance at the 10 % level; (+), (*), (†) indicate significance at the 15 % level

DIFFERENCE BETWEEN ABNORMAL RETURNS, DIFFERENT PERIODS

SAMPLE:	VC	NON-VC	PUBL	BANK	INDEP	CORP
(1)	-	-	-0.55 * (1.06) *9*	-0.44 (*) (3.32) *38*	0.21 ** (1.88) *63*	-0.08 (0.35) *8*
(2)	-	-	-0.19 + * (0.52) *9*	0.45 (2.43) *37*	0.30 (*) (1.92) *62*	-0.20 + (0.52) *8*
(3)	0.29 + (†) (1.95) *117*	-0.08 + (1.55) *190*	-0.20 (0.55) *9*	0.45 (2.39) *38*	0.30 (1.92) *62*	0.00 (0.18) *8*
(4)	0.29 +++ (†) (1.95) *117*	-0.54 +++ ††† (2.51) *190*	-0.20 * (0.55) *9*	0.45 + (2.39) *38*	0.30 ++ (1.92) *62*	0.00 (+) (0.18) *8*

DIFFERENCE BETWEEN RETURNS, SAME PERIOD

SAMPLE:	VC	NON-VC	PUBL	BANK	INDEP	CORP
(5)	-	-	-0.29 (0.84) *9*	-0.50 + (*) (2.18) *38*	0.25 ++ * † (0.97) *59*	0.00 (0.10) *8*
(6)	-	-	-0.15 + ** (0.50) *9*	0.67 (3.07) *36*	0.18 (*) (1.47) *59*	-0.08 (+) (0.35) *7*
(7)	0.31 + † (1.96) *112*	-0.07 + (1.68) *185*	-0.15 ** (0.53) *9*	0.60 (2.88) *37*	0.24 (1.42) *59*	0.00 (0.12) *7*
(8)	0.31 +++ † (1.96) *112*	-0.53 +++ ††† (2.72) *185*	-0.15 ** (0.53) *9*	0.60 + (2.88) *37*	0.24 ++ (1.42) *59*	0.00 (0.12) *7*

as well since they are matched only to venture-backed firms. The group of potential matching firms for venture-backed firms includes all firms with the exception of firms backed by the same type of VC as the sample firm. As a consequence of this design, in (1), (2), (5) and (6) the group of sample firms consists only of venture-backed firms whereas in (3), (4), (7) and (8), non venture-backed firms are included in the analysis as well.

Having defined the group of potential matching firms (e.g. non venture-backed firms in (2) and (6)) for each sample firm i, we search within this group for such companies that went public in a period that started three months before and ended three month after the IPO of the sample firm i. Within this restricted group of potential matching firms for firm i, we choose that control firm c that minimizes:

$$|\frac{MV_c - MV_i}{MV_{average}}| + |\frac{BTM_c - BTM_i}{BTM_{average}}|,$$

where $MV_{average}$ and $BTM_{average}$ are measured over the whole sample of 326 firms.

The mean differences in returns between sample and control firms in each group are depicted in table 6. We have 117 (112) pairs of matched firms in the first group (VC), 190 (185) firms in the group NON-VC, 9 firms in the group PUBL, 36-38 firms in the group BANK, 58-63 firms in the group INDEP and 7-8 firms in the group CORP. The reason for the difference in the number of matched pairs for different approaches is that in some cases no matching firm could have been identified since the set of potential matching firms has been empty. For seven firms that went public after the April 1, 2001, we did not have data on two-year-returns because our time-series on returns end in March 2003.[10] Eight firms left the market during the two years after their IPO. These firms (two of them are venture-backed) are not considered in table 6.

Venture-backed firms have significantly higher two-year returns than non venture-backed firms. This result is robust over the various matching approaches. The average returns on firms backed by public VCs are always lower than the average returns on matched firms. The difference in (abnormal) returns is particularly large when we match publicly-backed firms only to firms financed by another type of VC (approach (1) and (5)). On the whole, the difference in medians of the matched returns is almost always highly statistically significant and negative for public VCs compared to other groups. The average returns on firms backed by an independent VC are always higher than the average returns on other firms. When we match only

---

[10]Logically, for (5) - (8), where the measurement period starts three weeks after the IPO of the firm with the later IPO, the samples are smaller than in (1) - (4), where the two-year span begins at the IPO date.

within venture-backed firms, firms backed by an independent VC are the only group that has positive matched returns on average. The average difference in matched returns on firms backed by a corporate or a bank-dependent VC vary from approach to approach. Compared to other venture-backed firms, firms backed by a bank-dependent VC have significantly lower returns and firms backed by a corporate VC have approximately the same returns on average.

We carried through three further analyses to check the robustness of our results. First, we included firms that left the market during the period under consideration on the basis of their one-year returns to control for the potential survivor bias. Second, we matched firms on a portfolio- instead on the one-to-one-basis. Third, we used wealth relatives instead of the BHR. In all these alternative approaches, the positive impact of venture capital-backing, particularly of independent venture capital, on performance was confirmed. On the other hand, the inferior performance of companies backed by public VCs held as well. The results are not reported here.

3.5   Post-IPO Return Volatility

In this section, we look at the differences in the two-year post-IPO idiosyncratic volatility of returns. We will show that a part of this volatility can be explained by the IPO timing, the venture capitalists' and firm characteristics. In doing so we want to explore whether venture capitalists (resp. different types of venture capitalists) are better able to overcome potential informational asymmetries with respect to firm characteristics. The basic idea thereby is that venture capitalists can use their (current and/or future) reputation to price the shares of their firms better than in the case of non venture-backed firms. That implies that, in the aftermath of the IPO, there will be less adjustment towards the "true" market price, leading to less post-IPO fluctuation (see Neus/Walz (2003) for a detailed theoretical model of this hypothesis).

In table 7 we regress the two-year post-IPO idiosyncratic volatility (resulting from the CAPM) on some further variables concerning the firm characteristics, the market situation, the rank of designated sponsors and the lead underwriter(s), the VC's characteristics and involvement. We estimate six models which differ with respect to sample size and variables included. Several of our variables help explain a part of the idiosyncratic volatility.

In general, the participation of venture capitalists decreases the volatility as implied by Neus/Walz (2003). However, the venture capitalists' impact depends on their type and the extent of their lock-up. In line with our previous results, we find a positive impact of independent VCs. Companies backed by independent VCs

Table 7: Cross-section regressions of the idiosyncratic volatility

This table depicts the results of cross-section OLS regressions of idiosyncratic volatility (from CAPM).

The sample includes all venture-backed and all non venture-backed IPOs in the 1997-2002 period on the *Neuer Markt*, Frankfurt. We excluded VIVA.

t-statistics (corrected for heteroscedasticity using Huber-White-sandwich estimator) are in parentheses. Industry dummies are used as control variables, but not reported in the table. The coefficient of the constant used in the estimations is left out as well.

One, two and three asterisks indicate significance at the 10 %, 5 % and 1 % level. An asterisk in brackets points to significance at the 15 percent level.

	I: Full Sample	II: Full Sample and other market participants	III: Full Sample and VC	IV: VC-Sample and other market participants	V: VC-Sample and national origin	VI: VC-Sample and reputation
MV$(*10^{-9})$	−7.49 (−0.46)	−2.06 (−0.13)	−1.27 (−0.08)	−7.12 (−0.05)	−42.70 (−0.28)	−22.20 (−0.14)
BTM$(*10^{-9})$	1.22 (2.91)***	1.19 (3.28)***	1.22 (3.37)***	0.82 (1.00)	1.06 (1.42)	1.12 (1.51)(*)
AGE$(*10^{-9})$	−9.70 (−3.13)***	−12.90 (−4.52)***	−12.50 (−4.39)***	−8.42 (−1.99)**	−8.53 (−2.06)**	−9.53 (−2.29)**
SIZE$(*10^{-15})$	−0.09 (−0.00)	−98.60 (−0.45)	−113.00 (−0.53)	262.00 (0.36)	484.00 (0.67)	287.00 (0.39)
CORP$(*10^{-6})$				−5.87 (−0.08)		
INDEP$(*10^{-5})$	−11.01 (−2.62)***	−7.21 (−1.97)**		−7.28 (−1.65)(*)		
PUBL$(*10^{-5})$	−7.67 (−0.84)	−9.67 (−1.27)		−6.18 (−0.79)		
GERM$(*10^{-5})$					5.79 (1.47)(*)	
RANK$(*10^{-5})$						2.27 (1.49)(*)
LOCK$(*10^{-6})$	0.89 (2.10)**	0.68 (1.73)*	1.91 (3.05)***	2.06 (3.06)***	2.20 (3.18)***	2.03 (3.06)***
VC$(*10^{-5})$			−15.78 (−3.21)***			
DSRANK $(*10^{-5})$		−3.4 (−5.28)***	−3.29 (−5.16)***	−3.04 (−3.42)***	−3.13 (−3.40)***	−3.47 (−3.81)***
UNDRANK $(*10^{-6})$		5.35 (0.85)	3.10 (0.49)	−3.78 (−0.38)	−3.78 (−0.36)	−6.08 (−0.60)
HOTISSUE $(*10^{-5})$	−8.52 (−2.17)**	−5.28 (−1.54)(*)	−6.08 (−1.75)*	−4.80 (−0.85)	−4.82 (−0.92)	−6.00 (−1.13)
# of obs.	321	315	315	117	117	117
R^2	0.14	0.21	0.22	0.33	0.32	0.32

show a relatively lower idiosyncratic volatility than other firms (generating a higher return at the same time). Moreover, as expected, shares of foreign VCs and VCs with a better rank are less volatile. As short-term investors, venture capitalists try to divest themselves of their shares rather quickly. This leads to an increase in the volatility of these shares. Thus, the larger the lock-up by venture capitalists is, the higher is the idiosyncratic volatility.

Younger firms, which are more risky than their older counterparts, show a higher idiosyncratic volatility. Two results from table 7 contradict our predictions: The finding of a positive impact of the book-to-market ratio on the idiosyncratic volatility is inconsistent with the Fama/French (1993) result that value stocks are actually less volatile than the general market. We as well cannot explain why the reputation of designated sponsors plays a negative role and, thus, a better rank increases the volatility.

4 Underpricing

4.1 Our Focus

Several studies look at the differences in underpricing of venture- and non venture-backed companies (see section 1). Our focus is to a large extent a different one. Instead of comparing venture- and non venture-backed IPOs, we follow our previous route of analysis and investigate potential underpricing differences between the different types of venture capital firms. Thereby, we control for other factors such as growth potential (using the book-to-market-ratio as proxy) and firm size (proxied by market value).

We investigate the following VC-related hypotheses:

- Independent VCs are more able to resolve informational asymmetries. Their portfolio firms display less underpricing.

- Bank-dependent VCs are seen as having potential conflicts of interest with the underwriter (see Hamao et al. (2000) and Gompers/Lerner (1999a)) forcing them to underprice more than other venture-backed firms.

- Public VCs are mainly interested in the success of their IPO allowing therefore more underpricing.

- The more reputable and the older the VCs (see Gompers (1996) and Neus/Walz (2003)) are, the less pronounced underpricing is expected to take place.

4.2 Underpricing of IPOs Backed by Different Types of VCs

The results of our cross-section analysis are displayed in table 8. By and large we can not find any significant effects of the different types of VCs on the extent of underpricing when controlling for market value, book-to-market ratio, the age of the firm, the market conditions and the issue size. With the latter variable we take up the idea of Ljungqvist (1999). He argues that underpricing is less costly if the total size of the issue is small, thereby creating incentives to invest in costly marketing, in order to induce lower underpricing, only for large issues. Market conditions are approximated by the average extent of underpricing in the five IPOs preceding the respective firm (RECENT).

In neither regression we can find any significant impact of the different types of VCs on the degree of underpricing. The coefficient of BANK and PUBLIC is positive, as expected, indicating that firms backed by these types of VCs are underpriced to a larger extent. These coefficients are, however, never significant. Hence, the explanation of Hamao et al. (2000) for the higher degree of underpricing, namely the informational and incentive problems stemming from bank-dependent VCs being responsible for the higher underpricing level, is not supported by our data set. With respect to INDEP the sign is not clear-cut. Our Models IV-VI reveal a significant influence of the VC's reputation on underpricing. The sign of RANK is, however, in contrast to our theoretical considerations: The more reputable a VC is, the higher is the degree of underpricing of its portfolio firm. This negative and significant coefficient remains even if we include the VC-type variables and the GERM variable which has a positive impact on the extent of underpricing (see Models IV and VI). We do not find any support for the certification role of the underwriters.

The Ljungqvist-hypothesis that the size of the issue has a negative impact on the degree of underpricing is strongly supported in our regressions. We also find a strong positive impact of market conditions on the degree of underpricing. If previous issues have been heavily underpriced (indicating a hot issue period), it is most likely to be true for the issue under consideration. The book-to-market ratio has always a negative impact. That is, firms with a higher expected growth potential (i.e. with a lower book-to-market ratio) are more underpriced. Above this, larger and older firms are underpriced more which contradicts our intuition. On the contrary, a higher VCs' retention rate (LOCK) is obviously interpreted by the market as a signal and, thus, induces a lower underpricing.

Table 8: Cross-section regressions of underpricing

This table reports the results of different cross-section OLS regressions of underpricing.

The sample includes the entire sample of all venture-backed and all non venture-backed IPOs in the 1997-2002 period on the *Neuer Markt*, Frankfurt. We excluded two firms, VIVA and EM.TV.

t-statistics (corrected for heteroscedasticity using Huber-White-sandwich estimator) are in parentheses. Industry dummies are used as control variables, but not reported in the table. The coefficient of the constant used in the estimations is left out as well.

One, two and three asterisks indicate significance at the 10 %, 5 % and 1 % level. An asterisk in brackets points to significance at the 15 % level.

	I: Full Sample and VC	II: Full Sample and other market participants	III: Full Sample and VC-types	IV: VC-Sample and national origin	V: VC-Sample and VC-types	VI: VC-Sample, national origin and VC-types
MV$(*10^{-6})$	210.20 $(4.19)***$	208.80 $(4.24)***$	205.20 $(4.17)***$	2162.70 $(3.73)***$	2225.40 $(3.72)***$	2170.20 $(3.62)*$
BTM$(*10^{-6})$	-2.40 $(-2.57)**$	-2.47 $(-2.53)**$	-2.47 $(-2.58)***$	-2.46 $(-1.59)(*)$	-2.93 $(-1.79)*$	-2.78 $(-1.73)*$
AGE$(*10^{-6})$	8.76 (1.08)	10.40 (1.19)	8.66 (1.06)	22.30 $(2.32)**$	22.00 $(2.29)**$	22.70 $(2.31)**$
SIZE$(*10^{-9})$	-2.92 $(-4.58)***$	-2.92 $(-4.64)***$	-2.86 $(-4.57)***$	-10.20 $(-3.70)***$	-10.50 $(-3.75)***$	-10.10 $(-3.57)***$
RECENT	0.75 $(7.94)***$	0.75 $(7.82)***$	0.75 $(7.95)***$	0.47 $(5.02)***$	0.46 $(4.69)***$	0.47 $(4.92)***$
INDEP		-0.001 (-0.01)	0.02 (0.23)		-0.06 (-0.43)	0.01 (0.04)
BANK			0.09 (0.72)		0.11 (0.69)	0.10 (0.55)
PUBLIC			0.23 (0.95)		0.13 (0.51)	0.08 (0.31)
GERM				0.20 $(1.98)*$		0.17 (1.36)
RANK				-0.10 $(-2.99)***$	-0.08 $(-2.43)**$	-0.10 $(-2.93)***$
DSRANK		-0.003 (-0.16)				
UNDRANK		0.005 (0.29)				
VC	0.05 (0.78)					
LOCK				-0.003 $(-1.64)(*)$	-0.004 $(-1.97)*$	-0.003 $(-1.66)*$
# of obs.	318	312	318	118	118	118
R^2	0.35	0.34	0.35	0.48	0.48	0.48

5   Summary and Concluding Remarks

The main objective of the present paper was to investigate the impact of VCs' corporate governance, their experience and their objectives on the performance of their portfolio firms around and after the IPO. Thereby, we wanted to shed some additional light on the function of venture capital in nurturing and developing their portfolio firms as well on some mechanisms of the IPO market. Our main working hypothesis was that venture capital is too heterogenous as to simply allow to compare non venture and venture-backed firms.

In order to pursue our objective we compared the performance of firms backed by different VCs and non-venture backed firms in the course of the IPO, by looking at the extent of underpricing, as well as on post-IPO returns and volatility. Germany's *Neuer Markt* has proven to be a natural playing field for such a research strategy with a number of obvious advantages, but, however, with a disadvantage as well. The main advantage is that, due to the specific situation of the German venture capital market (young, rapidly growing market coupled with a strong public sector), we find a wide array of different types of venture capitalists with quite different structures, objectives and track record. Our main aim was to exploit just this difference and its impact on the performance of portfolio firms. The disadvantage is closely related to the advantages: Due to the relative youth of the *Neuer Markt* we just have a rather short time series forcing us to restrict our analysis to this short time span and to two-year performance measures. Despite these limitations we are strongly convinced that the advantages clearly outweigh the disadvantages.

With respect to post-IPO performance we find strong support for our hypotheses. Investors which have bought shares backed by independent VCs did significantly better in a two-year period after the IPO compared to the investors who relied on other (matching) firms in Germany's *Neuer Markt*. Somehow surprisingly these investors were able to sleep better since prices of their shares fluctuated significantly less. Investors having acquired shares of firms in which the lead VC was a public one bought into low returns. This leads us to the conclusion that different corporate governance structures, different experience levels and different objectives among the different types of VCs actually do have an observable and significant impact on the portfolio firms' post-IPO performance.

When looking into the determinants of underpricing we find rather little evidence that the extent of underpricing differs significantly among firms backed by different VCs. Furthermore, we find, rather surprisingly, that rank of the VC has a positive impact on underpricing. The fact that we were not able (due to the lack of data on issue costs, see Ljungqvist (1999)) to fully eliminate potential endogeneity problems

in our underpricing estimations, however, leads us to a rather cautious interpretation of our underpricing results.

Our findings on post-IPO performance as well as the ones in Tykvová (2003a) imply that the different types of VCs obviously fulfill their overall task as specialized monitors, consultants, and financier of young firms quite differently. Therefore, it would be very interesting to see whether these differences also exist in the pre-IPO period. We leave the task to investigate this with pre-IPO cashflow data for our future research.

References

AUDRETSCH, D. B., AND E. LEHMANN (2002): "Does the New Economy Need New Governance? Ownership, Knowledge, and Performance," Discussion Paper 3626, CEPR Discussion Paper.

BARBER, M. B., AND J. D. LYON (1997): "Detecting Long-Run Abnormal Stock Returns: The Empirical Power and Specification of Test Statistics," *Journal of Financial Economics*, 43, 341–372.

BARRY, C. B., C. J. MUSCARELLA, J. W. PEAVY, AND M. R. VESUYPENS (1990): "The Role of Venture Capital in the Creation of Public Companies," *Journal of Financial Economics*, 27, 447–471.

BASCHA, A., AND U. WALZ (2002): "Financing Practices in the German Venture Capital Industry: An Empirical Assessment," Center for Financial Studies Working Paper Series, No. 2002/08.

BECKER, R., AND T. HELLMANN (2000): "The Genesis of Venture Capital: Lessons from the German Experience," mimeo, Stanford University.

BESSLER, W., AND S. THIES (2002): "Initial Public Offerings, Subsequent Seasoned Equity Offerings, and Long Run Performance: Evidence from IPOs in Germany," Discussion paper.

BLACK, B. S., AND R. J. GILSON (1998): "Venture Capital and the Structure of Capital Markets: Banks versus Stockmarkets," *Journal of Financial Economics*, 47, 243–277.

BRAV, A., C. GECZY, AND P. A. GOMPERS (2000): "Is the Abnormal Return Following Equity Issuances Anomalous," *Journal of Financial Economics*, 56, 209–249.

BRAV, A., AND P. A. GOMPERS (1997): "Myth or Reality? The Long-Run Underperformance of Initial Public Offerings: Evidence from Venture and Nonventure Capital-Backed Companies," *Journal of Finance*, 52(5), 1791–1821.

BVK Jahrbuch 2002.

CUMMING, D. J. (2000): "The Convertible Preferred Equity Puzzle in Venture Capital Finance," mimeo, University of Alberta.

——— (2002): "Contracts and Exits in Venture Capital Finance," working paper.

DOUKAS, J. A., AND H. GONENC (2001): "Long-Term Performance of New Equity Issuers, Venture Capital and Reputation of Investment Bankers," working paper, SSRN.

ECKBO, B. E., AND Ø. NORLI (2000): "Leverage, Liquidity, and Long-Run IPO Returns," Discussion paper, Tuck School of Business at Dartmouth.

FAMA, E., AND K. FRENCH (1993): "Common Risk Factors in the Returns of Stocks and Bonds," *Journal of Financial Economics*, 33, 3–55.

FRANZKE, S. A. (2001): "Underpricing of Venture-Backed and Non Venture-Backed IPOs: Germany's Neuer Markt," working paper 2001/01, Center for Financial Studies.

GOMPERS, P. A. (1996): "Grandstanding in the Venture Capital Industry," *Journal of Financial Economics*, 42, 133–156.

GOMPERS, P. A., AND J. LERNER (1999a): "Conflict of Interest in the Issuance of Public Securities: Evidence from Venture Capital," *Journal of Law and Economics*, 42, 1–28.

———— (1999b): *The Venture Capital Cycle*. The MIT Press.

———— (2000): "The Determinants of Corporate Venture Capital Success: Organizational Structure, Incentives, and Complementarities," in *Concentrated Ownership*, ed. by R. Morck, pp. 17–50. University of Chicago Press.

———— (2003): "The Really Long-Run Performance of Initial Public Offerings: The Pre-Nasdaq Evidence," *Journal of Finance*, 58(4), 1355–1392.

HAMAO, Y., F. PACKER, AND J. R. RITTER (2000): "Institutional Affiliation and the Role of Venture Capital: Evidence from Initial Public Offerings in Japan," *Pacific-Basin Finance Journal*, 8, 529–558.

HELLMANN, T., L. LINDSEY, AND M. PURI (2003): "Building Relationships Early: Banks in Venture Capital," Discussion paper.

KOTHARI, S. P., AND J. B. WARNER (1997): "Measuring Long-Horizon Security Price Performance," *Journal of Financial Economics*, 43, 301–339.

LJUNGQVIST, A. P. (1997): "Pricing Initial Public Offerings: Further Evidence from Germany," *European Economic Review*, 41, 1309–1320.

——— (1999): "IPO Underpricing, Wealth Losses and the Curious Role of Venture Capitalists in the Creation of Public Companies," working paper, Oxford University and CEPR.

LOUGHRAN, T., AND J. R. RITTER (1995): "The New Issues Puzzle," *Journal of Finance*, 50(1), 23–51.

LYON, J. D., B. M. BARBER, AND C. TSAI (1999): "Improved Methods for Tests of Long-Run Abnormal Stock Returns," *Journal of Finance*, 54(1), 165–201.

MEGGINSON, W. L., AND K. A. WEISS (1991): "Venture Capitalist Certification in Initial Public Offerings," *Journal of Finance*, 46(3), 879–903.

NEUS, W., AND U. WALZ (2003): "Exit Timing of Venture Capitalists in the Course of an Initial Public Offering," Center for Financial Studies Working Paper Series, No. 2002/07.

RINDERMANN, G. (2003): "Venture Capitalist Participation and the Performance of IPO Firms: Empirical Evidence from France, Germany, and the UK," Discussion paper.

RITTER, J. R. (1991): "The Long-Run Performance of Initial Public Offerings," *Journal of Finance*, 46(1), 3–27.

RITTER, J. R., AND I. WELCH (2002): "A Review of IPO Activity, Pricing, and Allocations," *Journal of Finance*, 57(4), 1795–1828.

ROCK, K. (1986): "Why New Issues Are Underpriced," *Journal of Financial Economics*, 15, 187–212.

SMART, S. B., AND C. J. ZUTTER (2003): "Control as a Motivation for Underpricing: A Comparison of Dual-and Single-Class IPOs," *Journal of Financial Economics*, 69(1), 85–110.

TYKVOVÁ, T. (2003a): "Is the Behavior of German Venture Capitalists Different? Evidence from the *Neuer Markt*," Discussion Paper 03-44, ZEW.

——— (2003b): "Venture-Backed IPOs: Investment Duration and Lock-Up by Venture Capitalists," *Finance Letters*, 1(2), forthcoming.

CFS Working Paper Series:

No.	Author(s)	Title
2003/40	**Athanasios Orphanides** **John C. Williams**	Imperfect Knowledge, Inflation Expectations, and Monetary Policy
2003/41	**Sharon Kozicki** **P.A. Tinsley**	Permanent and Transitory Policy Shocks in an Empirical Macro Model with Asymmetric Information
2003/42	**Mordecai Kurz** **Hehui Jin** **Maurizio Motolese**	The Role of Expectations in Economic Fluctuations and the Efficacy of Monetary Policy
2003/43	**William A. Brock** **Steven N. Durlauf** **Kenneth D. West**	Policy Evaluation in Uncertain Economic Environments
2003/44	**Timothy Cogley** **Sergei Morozov** **Thomas J. Sargent**	Bayesian Fan Charts for U.K. Inflation: Forecasting and Sources of Uncertainty in an Evolving Monetary System
2003/45	**Guenter W. Beck**	Nominal Exchange Rate Regimes and Relative Price Dispersion: On the Importance of Nominal Exchange Rate Volatility for the Width of the Border
2003/46	**Michael Ehrmann** **Marcel Fratzscher**	Equal size, equal role? Interest rate interdependence between the euro area and the United States
2003/47	**Romain Bouis**	IPOs Cycle and Investment in High-Tech Industries
2003/48	**Martin D. Dietz**	Screening and Advising by a Venture Capitalist with a Time Constraint
2004/01	**Ivica Dus** **Raimond Maurer** **Olivia S. Mitchell**	Betting on Death and Capital Markets in Retirement: A Shortfall Risk Analysis of Life Annuities versus Phased Withdrawal Plans
2004/02	**Tereza Tykvová** **Uwe Walz**	Are IPOs of Different VCs Different?