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**Post-IPO Performance  
and  
the Exit of Venture Capitalists**

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## Post-IPO Performance and the Exit of Venture Capitalists

### *Abstract*

We test several implications of venture capital investment for the post-IPO performance of firms using data of 312 IPOs on Germany's *Neuer Markt*. Through tighter corporate control, third party certification and a reduced heterogeneity of opinions companies financed by Venture Capital firms might outperform their counterparties in the aftermarket of an IPO. However, this positive effect of VC backing on aftermarket performance could be reversed when Venture Capitalists seek exit from their investment. The discontinuation of a blockholder's exercised corporate control, signalling of insider knowledge as well as possible downward sloping demand curves provide an analytical framework that explains why the return series of VC backed IPOs might show a significant breakpoint at the time when Venture Capitalists exit from their investments. Our empirical evidence suggests that the expiration of lock-up periods as the earliest possible point of time for an exit represents such a breakpoint as Venture Capital backed IPOs outperform their counterparts before, but underperform around and after the expiration.

Keywords: venture capital, initial public offerings, long-run performance  
JEL: G24; G32; M13

## 1. Introduction

This paper aims to extend the knowledge about the performance of shares in the years after initial public offerings (IPOs) by examining the post-IPO performance of Venture Capital (VC) backed IPOs with a special focus on the impact of a venture capitalist's exit decisions on performance. In content it is thus related to Brav/Gompers (1997), Gompers/Lerner (1998), Doukas/Gonenc (2000) and extends the US-based evidence with data on Germany's *Neuer Markt*, which has been the leading European market for innovative growth firms from its foundation in 1997 until the implementation of a new segmentation concept of the Frankfurt stock exchange at the end of 2002. With this focus, the paper also adds to a recent strand of empirical research about the pricing and performance of *Neuer Markt* IPOs such as e.g. Francke (2001), Mayer (2001), Kraus (2002) and Nowak/Gropp (2002).

In general, IPO firms underperform their equivalents at stock exchanges<sup>1</sup> which is explained with agency problems, the heterogeneity of opinions and a resulting winner's curse problem. However, Venture Capitalists (VCs), who finance small, growth companies and act as specialised monitors and certifying agents, might help to overcome agency problems and reduce the divergence of opinions. Hence, VC backing might reduce underperformance. VCs are forced by lock-up agreements to maintain a significant economic interest in the firm after the IPO. However, after the expiration of lock-up agreements they usually exit from matured investments and consequently terminate monitoring and certification services. From that date onwards, formerly VC backed IPO firms should not perform differently from others. Furthermore, the exit of VCs may have a negative impact on prices over and above the termination of monitoring. Signalling effects and a sudden increase in the supply of shares are amongst the most important reasons for negative abnormal returns around the expiration date.

To test these hypotheses, we analyse a sample consisting of IPOs at the *Neuer Markt* ranging from its start in March 1997 to August 2001. Firstly, it is examined whether VC backed IPOs performed differently from more seasoned stocks and from other, non-VC backed IPOs during 18 months after the IPO. The robustness of the results is checked against various other lines such as size, industry, time of the IPO or underwriter reputation. The second set of tests concentrates on the performance impact of the exit decision with the expiration date of lock-up agreements as a proxy for the exit date. The short run implications of the expiration of lock-up agreements are examined within an event study framework similar to Field/Hanka (2001) and Brav/Gompers (2000). VC backed IPOs show larger negative abnormal returns and higher increases in abnormal trading volume compared with non-VC backed firms. Multivariate analysis confirms VC backing in interaction with prior performance and free float as the main driver. The long run implications of the expiration of lock-up agreements are tested with a dummy variable approach and Chow Breakpoint tests. VC backed IPOs seem to perform significantly better before than after the expiration of lock-up periods which partly supports the hypothesis that the exit of VCs represents a breakpoint in the post-IPO performance series of VC backed firms.

The remaining sections are organized as follows. Section 2 provides the relevant theoretical framework of post-IPO performance, VC backing and exit decisions. Besides, it surveys prior empirical evidence. Section 3 describes the data and the employed methodology. The results of the various empirical tests are presented and discussed in section 4. Section 5 concludes the paper and gives implications for the VC business.

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<sup>1</sup> See, e. g., Ritter/Welch (2002) on the empirical evidence.

## 2. The Unwinding of Venture Capital and Post-IPO Performance

### 2.1 The Underperformance Phenomenon

#### 2.1.1 Empirical Evidence of Underperformance

Over and above the examination of short-run IPO returns, the underpricing phenomenon<sup>2</sup>, and time-wise clusters, ‘hot issue markets’<sup>3</sup>, academic research investigated the long-run performance of IPOs. As opposed to literature on underpricing, post-IPO performance studies assume a buy & hold (B&H-) strategy for allotted shares rather than a trading strategy aiming to exploit the initial discount (underpricing) of IPOs so that such studies essentially examine the after-market’s semi-strong form efficiency.<sup>4</sup>

Regulatory requirements force issuing firms to file with the stock exchange before an IPO and to provide investors with all relevant information in an offering prospectus.<sup>5</sup> Hence, IPOs are not expected to perform differently on a risk-adjusted basis from a control sample since no unexpected IPO-unique information should systematically hit the market. Empirical evidence, however, does not support this efficient market hypothesis. Ritter (1991) found IPOs from 1975 to 1984 to underperform various market indices as well as industry- and size-matched portfolios on a market-adjusted basis over a three-year horizon. Promoters of the efficient market hypothesis would expect the difference to be arbitrated away after its discovery. However, according to supporting evidence from other equity markets and time frames, the long-run performance of IPOs seems to be a persistent stylized fact of equity markets.<sup>6</sup>

#### 2.1.2 Possible Explanations of Underperformance

Attempts to explain the persistent long run underperformance of IPOs can be divided into those stemming from the underpricing literature and those based on a behavioural finance background.<sup>7</sup> Some of the equilibrium models that explain initial underpricing predict also post-IPO performance. Signalling models,<sup>8</sup> e.g., claim that good firms underprice to reveal their quality and achieve higher proceeds in subsequent SEOs, thereby predicting that good firms have a positive after market performance. Thus, firms that underprice (more) should exhibit better post-IPO performance. In market feedback models<sup>9</sup> or theories of bookbuilding,<sup>10</sup> the employed pricing method allows for the (partial) adjustment of issue prices in response to investor’s favourable information prior to the IPO. Underperformance may occur when underwriters incorporate favourable information to a higher extent than unfavourable information or simply when more cases of negative information occur.

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<sup>2</sup> See the initial paper of Ibbotson (1975), who found significantly positive risk-adjusted first trading month returns of 11.4% for US IPOs between 1960 and 1969. For different time frames and markets see also the extensive overview reported by Anderson et al. (1995), for Germany specifically e.g. Kaserer/Kempf (1995)

<sup>3</sup> Ritter (1984) showed that IPOs in the US during the 15 months from January 1980 onwards yielded an initial return of 48.4% compared with 16.3% for other IPOs in the 1977-1982 time window. He also documented an industry cluster of abnormally high returns. See also the German evidence reported by Ljungqvist (1996).

<sup>4</sup> See Fama’s (1970), (1991) work on the idea of market efficiency and its three different forms.

<sup>5</sup> See for information requirements in the course of IPOs on the Frankfurt Stock Exchange e.g. Schanz (2000)

<sup>6</sup> See for an overview Jenkinson / Ljungqvist (2001), Table 2.2 on p. 55 and specifically Wasserfallen / Wittleder (1994) as well as Ljungqvist (1997) for German evidence.

<sup>7</sup> See for an overview of the various explanations and their empirical power Jenkinson / Ljungqvist (2001)

<sup>8</sup> See Grinblatt/Hwang (1989), Allen/Faulhaber (1988) or Welch (1989).

<sup>9</sup> See Benveniste/Spindt (1989).

<sup>10</sup> See Benveniste/Wilhelm (1997) and Voigt (1997) for further information on IPO allocation and pricing procedures in general and book building in particular.

The empirical evidence for signalling models is conflicting. The most important prediction of a positive correlation between underpricing and post-IPO performance is widely rejected.<sup>11</sup> Empirical evidence on market feedback models is rare since the revelation of information is not directly observable. However, Hanley (1993) found the deviation of the initial price from the book building range to be of low predictive power for long run underperformance.<sup>12</sup>

Agency cost explanations build on Jensen/Meckling's (1976) hypothesis that lower levels of managerial ownership are followed by increasing agency costs as the conflict of interest between outside investors and managers becomes more severe. Since dilution and direct sales of secondary shares reduce managerial ownership within IPOs, one would expect higher agency costs and lower operating performance and thus lower firm values after IPOs. Mikkelson et al. (1997) found a positive relation between post-IPO operating return on assets and inside ownership.<sup>13</sup> Overall retention rates, i.e. the maintained ownership of all pre-IPO shareholders, are also positively related to operating returns after the IPO.<sup>14</sup> Hence, empirical evidence provides support for Jensen/Meckling's (1976) hypothesis of the agency costs of divergence of interests. However, agency models fail to completely explain the long-run underperformance as rational investors should anticipate the decline in operating performance.<sup>15</sup>

The second line of explanations is based on investors' behaviour and expectations. The divergence-of-opinion theory explains underperformance through heterogeneous expectations and thus different private valuations across investors.<sup>16</sup> IPOs usually are allocated in an auction-like book building process with bounded issue prices.<sup>17</sup> The most optimistic investors will place the highest bids and will therefore receive the issue. Hence, the issue price does not reflect *all publicly* available information but only the *private* information and valuation of the marginal investor.<sup>18</sup> In the after-market, prices decrease through arbitrage until they reflect all publicly available information. Underperformance should hence be related to the initial extent of diverging opinions and to the speed of convergence of opinions and information.<sup>19</sup>

## 2.2 The Positive Effect of Venture Capital on post-IPO Performance

### 2.2.1 Empirical Evidence

VCs may help to reduce post-IPO performance in a way similar to bulge bracket investment banks with IPOs underwritten by such highly reputable investment banks being found to perform better than IPOs underwritten by other banks.<sup>20</sup> Brav/Gompers (1997) found VC backed IPOs outperforming non-VC backed IPOs on basis of equally weighted returns. While non-VC backed IPOs underperformed various benchmarks, portfolios consisting of VC backed IPOs did not show significant underperformance. By constructing portfolios based on the di-

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<sup>11</sup> See the summary of empirical studies reported by Jenkinson/Ljungqvist (2001), Table 6.1.

<sup>12</sup> See Hanley (1993), pp. 247-249 and Table 4.

<sup>13</sup> See Mikkelson et al. (1997), Table 4, year 1.

<sup>14</sup> See Jain/Kini (1994), pp. 1709-1714.

<sup>15</sup> Jenkinson/Ljungqvist (2001), p. 148.

<sup>16</sup> See e.g. Harris/Raviv (1993), pp. 473-476 for the implications of heterogeneous beliefs.

<sup>17</sup> In 1999, e.g., out of 168 IPOs on Frankfurt Stock Exchange only one issue was designed as a fixed price offering. See Deutsche Boerse (1999), pp. 15-20.

<sup>18</sup> Clearly, it is necessary to rule out the possibility of shortsales in primary markets. Restricted supply of shares in the after market as denoted by Aggarwal/Rivoli (1990), pp. 53,54 provide support for this assumption.

<sup>19</sup> Houge et al. (1999), pp. 11-20, provide empirical support for the divergence-of-opinions explanations with various proxies for heterogeneous beliefs such as first time of trade or block trade occurrence.

<sup>20</sup> See Carter/Dark/Singh (1998), Table 5 and Table 6 with significant differences in medians between low, medium and high reputation underwriters.

mensions of VC backing and size, Brav/Gompers (1997) find that, in their sample, “underperformance [...] comes primarily from small, non-VC backed IPOs”.<sup>21</sup> Doukas/Gonenc (2000) with 1989 to 1994 US data as well as Van Frederickslust/van der Geest (2000) with a 1985 to 1998 Dutch sample confirm superior performance of VC or Private Equity backed<sup>22</sup> IPOs.

One popular-press magazine reports that VC backed IPOs performed worse than non-VC backed stocks in the early days of the *Neuer Markt* until March 2000, but lost less than their counterparts during the ensuing bear market.<sup>23</sup> The authors conclude that overall VC backing does not influence post-IPO performance. Another article found only half of the VC backed companies to outperform the market. An equally-weighted portfolio of VC backed stocks, however, performed three times better than the NEMAX All Share Index as a benchmark because of some outliers.<sup>24</sup> It appears that VC backing has a positive effect on post-IPO performance. The presence of VCs (or private equity firms) apparently might mitigate underperformance in the after-market. How can this positive impact of VCs be explained?

### 2.2.2 Venture Capitalists as Lenders of Reputation and Certifying Agents

VCs are long-term investors in young and privately-held firms.<sup>25</sup> Young firms have neither an established tracked record nor have they gained a reputation for good management or product quality. This lack of reputation can cause severe problems to the venture: customers or suppliers may be unwilling to enter contracts with a ‘no-name’ company. Insufficient management skills are perceived to be one of the greatest risks of (early stage) VC investing.<sup>26</sup> VCs try to overcome these problems of uncertainty, lack of track records and experience by providing not only capital but also credibility within their network of contacts.<sup>27</sup>

As VCs are repeated players in capital markets, they can build a reputation for being experts in evaluating young firms which helps VCs signal a company’s value and trustworthiness to potential stakeholders. VCs rely on reputation for three crucial reasons. Firstly, raising capital for follow-on funds becomes easier for highly reputable VCs.<sup>28</sup> Secondly, reputable VCs find it easier to receive co-investment opportunities in later financing rounds in the context of stage financing<sup>29</sup> since “established firms are unlikely to involve either new funds or small unsuccessful organizations as co-investors”.<sup>30</sup> Consequently, top VCs maintain more such links than other VCs.<sup>31</sup> Last, but not least, a VC’s reputation is important to receive a sufficient number of investment proposals from capital seekers. The importance of reputation en-

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<sup>21</sup> Brav/Gompers (1997), p. 1818.

<sup>22</sup> Although some authors differentiate between VC and Private Equity firms with a focus on technology firms as the main difference, we treat include both groups for the purpose of this study similarly.

<sup>23</sup> Going Public (2001), pp. 66, 67.

<sup>24</sup> See Mackewicz&Partner (2001), p.12. Interestingly, in the Going Public magazine underperformance of the VC backed portfolio is justified with some extreme outliers in the non-VC backed portfolio, whereas Mackewicz&Partner stipulated exactly the opposite.

<sup>25</sup> Typically, VCs are limited partnerships in the US and *Kommanditgesellschaften* in Germany where the VC acts as a general partner (GP) or *Komplementär* and investors take positions as limited partners (LPs) or *Kommanditisten*. The life-span of these fund vehicles is usually limited to 10 years with a pre-specified extend option. See, e.g., Sahlman (1990), pp.489, 490.

<sup>26</sup> According to Rhunka/Young (1991), Table 1, p. 122 insufficient management skills are perceived to be one of the greatest risk in (early stage) VC investing.

<sup>27</sup> See Black / Gilson (1998), pp. 254, 255.

<sup>28</sup> See Gompers (1996), p. 136.

<sup>29</sup> See Gompers (1995).

<sup>30</sup> Lerner (1994), p. 17.

<sup>31</sup> See Bygrave (1988), pp. 143-146.

ables VCs to credibly certify a firm's quality. Thus, VCs essentially lend reputation to portfolio companies, a so-called third party certification.<sup>32</sup> The certified signal, in return, helps firms to enter otherwise unattainable contractual agreements with potential business partners. This is an explanation for a better post-IPO performance of VC backed firms. Firms backed by VCs have better access to top tier underwriters<sup>33</sup> or auditors<sup>34</sup> which relaxes financial constraints so that VC backed firms should *ceteris paribus* have higher firm values. If market participants fail to incorporate the impact of VCs on firm values at the time of the IPO correctly, post-IPO performance will differ between the two firms as soon as the superiority of VC backed firms is revealed. Furthermore, certification by VCs may reduce the heterogeneity, i.e., the spread of expectations, which, in return, will reduce underperformance of VC backed IPOs.

### 2.2.3 Venture Capitalists as Monitoring Specialists

VC investing is characterized by asymmetric information in both, an ex-ante form with hidden characteristics (e.g., uncertainty about the quality of management teams), and in an ex-post form with hidden action (e.g., the effort of managers).<sup>35</sup> VCs try to solve this problem by shifting risks to the entrepreneur. This asymmetric risk allocation should align managers' and investors' interests and provide entrepreneurs with the necessary incentives. Such a risk shift can be enforced by a sub optimal wealth diversification for managers in the spirit of Leland/Pyle (1977) or put options, so called "Managerial Redemption Rights"<sup>36</sup>, that allow VCs to resell their stakes to the entrepreneur if certain milestones are missed.

VCs also act as monitoring agents by holding board seats with a disproportionately high relative share of voting rights compared to the related ownership position.<sup>37</sup> Furthermore, Baker/Gompers (2001) find that the board composition of VC backed IPOs firms differs significantly from that of non-VC backed IPOs. The boards of VC backed firms comprise a lower percentage of inside and instrumental directors (such as bankers) and consist of a higher percentage of independent outside directors.<sup>38</sup> They conclude that "VCs, as large outside shareholders, reduce the power of the CEO to control the firm and extract private benefits".<sup>39</sup> As active monitors, VCs get involved with the daily activities of their portfolio companies<sup>40</sup> and receive detailed financial information on a monthly basis.<sup>41</sup> This information flow allows VCs to react promptly to unfavourable developments.<sup>42</sup> In troubled firms, VCs intensify their monitoring by increasing board representation with the next negotiated financing round.<sup>43</sup> The exercised corporate control and governance suggest a second explanation for superior post-IPO performance of VC backed firms. If market participants fail to anticipate lower

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<sup>32</sup> On third party certification by underwriters see Booth/Smith (1986) or Johnson/Miller (1988).

<sup>33</sup> This is confirmed by the findings of Barry (1990) et al., Table 4.

<sup>34</sup> As reported by Megginson/Weiss (1991), Table 5 and p. 890-892.

<sup>35</sup> See Hartmann-Wendels (1987), pp. 18-20.

<sup>36</sup> See the term sheet and related explanations in Silver (1984), pp. 203-217 and 231-235.

<sup>37</sup> Lin/Smith (1998) e.g. show that VCs held on average 13% of board seats after an IPO but before exiting completely, while they only hold 11% of outstanding shares. See Table 5, p. 255.

<sup>38</sup> See Baker/Gompers (2001), Table 2 and pp. 11-14.

<sup>39</sup> Baker/Gompers (1999), p. 24.

<sup>40</sup> Elango et al. (1995), p. 165, found VCs to spend on average 20 hours per month on the premises of their portfolio companies.

<sup>41</sup> See Sahlman (1990), p. 505.

<sup>42</sup> See Lerner (1997), p. 22.

<sup>43</sup> See Lerner (1995), Table II and Table III, with a data set of biotechnology firms.

agency costs in VC backed firms, these will outperform their counterparts in the aftermarket as the effect of the higher level of corporate control becomes apparent.<sup>44</sup>

### 2.2.4 Other Explanations for a Superior Performance of VC Backed IPOs

VCs' certification services and lower informational asymmetries lead to a higher institutional ownership in VC backed firms.<sup>45</sup> This can explain a superior performance of VC backed firms along the lines of Field's (1995) findings of a negative correlation between institutional ownership and underperformance. VCs may also attract better analyst coverage for their IPOs<sup>46</sup> which increases the information momentum of a stock and thus enhances performance.<sup>47</sup>

Furthermore, public companies are exposed to greater public scrutiny private companies. Thus, the risk of losing its reputation is higher for a VC when it floats companies on the transparent public markets than when it sells stakes in a private-to-private transaction. Hence, VCs will carefully select the firms they intend to bring to the public market<sup>48</sup> and will only try to float the most promising ventures.<sup>49</sup> Since this selection mechanism is non-existent for non-VC backed firms,<sup>50</sup> the overall quality of a sample of such firms may well be lower than that of a sample of VC backed firms, suggesting that, if investors fail to participate the effect fully, a portfolio of VC backed IPOs companies will outperform non-VC backed IPOs.

## 2.3 Contrary Effects of Venture Capital Exits

### 2.3.1 The Need to Exit from Venture Capital Investments

In opposition to the prior analysis some adverse effects have to be considered. Firstly, from a VC's perspective, although an IPO has some importance for, e.g., reputational concerns, an IPO is, to some degree, a 'non-cash event' since VCs sell only fractions of their holdings in the IPO. Barry et al. (1990) as well as Lin/Smith (1998) found that VCs sell, on average, only 6%-points of their shares during the IPO, the median being 0. Burghof/Fischer (2002) with a *Neuer Markt* sample observe a higher selling intensity of about 25% for their VC backed

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<sup>44</sup> Brav/Gompers (1997), pp.1792, 1793 refer to this as "[...] management structures in place that help the firm to perform better in the long run".

<sup>45</sup> See Megginson/Weiss (1991), Table 5 and p. 892.

<sup>46</sup> See Brav/Gompers (1997), p. 1793.

<sup>47</sup> See Aggarwal et al. (2001), pp. 23-25 and Table 6.

<sup>48</sup> Sanjiv et al. (2002), Table 4 and p. 9 estimate the probability of a VC backed firms to go public to be roughly 20-25%. Peng (2001), Table 1 provides a similar figure.

<sup>49</sup> Chiampou/Kallet (1989) report an average return of 17.5% earned on a three-year old VC portfolio. By comparison, according to Cochrane (2000), log-returns of floated ventures were around 100% p.a. Bygrave/Timmons (1992) report an average annual compounded rates of return of even 163%-208% p.a. depending on the initial investment round. Gompers (1995) found compounded annual returns on floated investments to be as high as 60% while investments exited with trade sales only earned 15% p.a. Peng (2001) estimates a realized annual return of 293% for IPOs versus 113% for acquisitions. Cumming/MacIntosh (2000) report higher *unannualized* (gross) real returns for floated portfolio companies but higher *annualized* real returns for portfolio companies exited with trade sales (acquisition); however, the fact that investment cycles are shorter for floated firms is contradicts the order of annualized returns.

<sup>50</sup> Since both, VC and non-VC backed firms also have to pass an underwriter's due diligence, this statement assumes that underwriters' and VCs' screening are not complementary to each other.

sample. Since the mere occurrence of an IPO is thus in most cases not an exit,<sup>51</sup> it is natural to ask, why, how and when VCs exit from floated portfolio companies.<sup>52</sup>

Firstly, why do VCs have to exit?<sup>53</sup> Uncertainty and investment risk gradually decrease with increasing maturity of the company and so, in turn, does the return on investment so that early stage investors expect higher returns.<sup>54</sup> The maximization of returns on investment, including human capital in form of the acquired industry- and entrepreneurship-specific knowledge requires VCs to recycle their investments after a company has reached a certain level of maturity and no longer requires the VC's management assistance, reputation and close scrutiny.<sup>55</sup>

Furthermore, the relation between VCs and their investors provides further reasons to exit from portfolio companies. The impossibility of premature redemption of capital in partnerships without the limited partners' (LP) approval, and the limited tradability of partnership units require a fixed termination date for the VC fund. Termination and redemption on a fixed date allow investors to reallocate their investment and withdraw from unsuccessful managers, and to adjust their overall personal asset allocation.<sup>56</sup> Therefore, VCs have to plan exits from their investments, including floated companies, within a certain period of time.

VCs can exit from already floated companies by either selling shares in the open market, disposing in blocks in private placements or by distributing shares<sup>57</sup> to their investors. Placing orders in the open market may have a direct negative pricing impact especially in a thin trading environment. Block sales mitigate the selling's impact on bid-ask-spreads. On the other hand, fees to banks are expected to be higher and block discounts common. Distributions mitigate the impact further as their occurrence is private knowledge and the actual selling decision is delegated to each single investor.

Evidence on the timing of sales of VCs is rare since VCs do not have to disclose sales.<sup>58</sup> Gompers/Lerner (1998) found that the median VC distributed shares in the first instance within one year of the IPO. The earliest possible time to dispose stakes is with the end of the so-called lock-up agreement. VCs are very reluctant to warehouse freely tradable stocks after the lock-up agreements has expired, and, if so, only because of abnormal future returns or the impossibility to sell shares directly.<sup>59</sup> Hence, the classification of a company as being VC backed will alter presumably soon after the termination of lock-up agreements. What are the consequences of the termination of the VC-company relation for post IPO performance?

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<sup>51</sup> Interestingly, both, North American and European VC literature distinguish between trade sales/mergers, secondary sales, buybacks, write-offs and IPOs as exit vehicles despite of the non-Exit nature of IPOs.

<sup>52</sup> See Wall/Smith (2000), p. 8 who remark on the non-exit nature of IPOs that "continued shareholding carries a risk that gains may not be realised and VCs lose the special rights they have in a private company".

<sup>53</sup> See for a short overview of exit strategies e.g. Ivanova/Tzevtkova (2001), pp. 165-191.

<sup>54</sup> Manigart et.al. (2002) e.g. found the required IRR of early stage investors with 40% to be substantially higher compared to later stage private equity investors with a required IRR of 28%. Deloitte&Touche (2001) with a survey amongst 53 private equity firms with operations in Germany found similar evidence with early stage VCs requiring IRRs of, on average, 32% vs. 24.7% for late stage/buy out VCs.

<sup>55</sup> Smith (2001), p. 3 refers to this as "[...] the value added will decline to the point where it equals or exceeds the maintenance costs."

<sup>56</sup> See Black/Gilson (1998), pp. 255, 256.

<sup>57</sup> See Gompers/Lerner (1998), pp. 2164, 2165. Since distributions are uncommon in Germany, we will focus in our study on actual sales.

<sup>58</sup> See Field/Hanka (2001), p. 475.

<sup>59</sup> See Deloitte&Touche (2001), p. 23 and Figures 11, 12.

### 2.3.2 Termination of Monitoring Efforts with the Exit

VCs can be expected to discontinue their monitoring activities after the exit. Consequently, Lin/Smith (1998) report that VCs' percentage of board seats decreases from 13.6% to 4.9% after the exit.<sup>60</sup> This change in the level of outside corporate control has two effects compared to non-VC backed firms. Firstly, the discontinuation of monitoring efforts of a block holder with constant managerial ownership itself is expected to decrease firm values. Secondly, the existence of the VCs' block holdings causes lower levels of managerial ownership relative to non-VC backed firms.<sup>61</sup> Before the VC's exit, the VCs monitoring counterbalanced the resulting negative incentives. Afterwards, this is no longer the case, and agency costs should rise to higher levels if the VC is not adequately replaced by another block holder. Thus the "unanticipated dissolution of a large block holder provides an [...] explanation for stock price declines at the time of the distribution",<sup>62</sup> and VC backed firms are particularly hard hit when VCs exit and might underperform for some time after the exit.<sup>63</sup>

### 2.3.3 The Exit as a Signal for Insider Knowledge

Superior information may enable VCs to infer possible market mispricings of their portfolio companies and to exploit their superior knowledge for the timing of exits. Thus, a VC's selling decision may signal overvaluations and result in subsequent downward adjustments of prices. Hence, post-exit performance of VC backed IPOs is expected to be negatively affected by the insider role of VCs. This does not hold for corporate insiders of non-VC backed firms for three reasons: Firstly, as opposed to VCs, corporate insiders can trade on both, positive and negative information. VCs, however, are restricted from buying shares of public firms and thus can only make use of unfavourable private information. Secondly, VCs are obliged to exit from their investments, whereas corporate insiders are not restricted. Thirdly, respective actions of corporate insiders<sup>64</sup> are restricted by insider trading laws while the insider position and trading of VCs is much harder to trace. VCs in Germany are e.g. not covered by filing and disclosure obligations when selling shares.<sup>65</sup> Hence, the framework of insider trading provides a second potential reason for a negative post-exit performance of VC backed firms.

### 2.3.4 Demand and supply as drivers

The increase in the supply of freely tradable shares<sup>66</sup> caused by the exit of VCs may result in price decreases sufficient to attract enough buyers and compensate them for the provision of liquidity if demand curves are not fully elastic and markets not efficient in the short run.<sup>67</sup> Depending on the long-run elasticity of demand curves, prices may bounce back to the previous equilibrium level such that there exists only short-term price pressure or the price de-

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<sup>60</sup> See Lin/Smith (1998), Table 5, p. 255.

<sup>61</sup> Note that this is subject to two assumptions. Firstly, non-VC backed IPOs are expected not to compensate the lack of VC by forcing financing from other outside investors but rather by increasing financing from insiders. Secondly, it is assumed that the VC after exiting from its investment is not replaced adequately by another block holder.

<sup>62</sup> Gompers/Lerner (1998), p. 2169

<sup>63</sup> In order to distinguish post-IPO performance and performance subsequent to a VC's exit we will refer to the latter one as post-exit performance.

<sup>64</sup> See Bhattarchaya/Daouk (2002), pp. 86-89.

<sup>65</sup> See for Germany Schanz (2000), p. 473.

<sup>66</sup> See the literature on block holder sales, e.g., Harris/Gurrel (1986).

<sup>67</sup> See e.g. Allen/Postlewaite (1984), p.1119,1120.

crease may persist in the long run if long-term demand curves are downward sloping.<sup>68</sup> Price pressure and downward sloping demand curves should have an impact on both VC as well as non-VC backed IPOs. However, since VCs are the group that is most likely to exit quickly after the expiration of lock-up agreements, the effects should be most significant for VC backed firms. The respective supply shocks should even occur when shares are distributed as stock dividends since most investors sell shares straight after the distribution. Thus, “Venture Capital-financed firms are likely to have more shares sold at the lock-up expiration and hence have greater price declines”.<sup>69</sup>

### 2.3.6 Testing the price implication of Venture Capitalists’ exits

Gompers/Lerner (1998) tested the impact of the exit of VCs on short-run and long-run performance directly with a sample of distributions constructed from the files of four VC investors between 1980 and 1993. Immediately after a distribution, VC backed IPOs underperform the CRSP Value-weighted NASDAQ Index by around 6% over 100 days while they outperform prior to the distribution which is the expected result derived from the analysis conducted here. In the longer run, results are more ambiguous and depend on the employed benchmark.<sup>70</sup>

From our data, the exit of VCs is not directly observable. However, Gompers/Lerner (1998) and Deloitte&Touche (2001) confirm that VCs tend to dispose their holdings immediately after the end of lock-up periods. Also, investors, not knowing when VCs will actually exit, might anticipate an exit on the first possible date, viz. when the lock-up agreement expires. Thus, this date can be used as a proxy for the true selling date. Consistent with this, Field/Hanka (1999) find VC backed firms to underperform not only the CRSP value weighted index over the three days around the lock-up expiration, but also a sample of non-VC backed firms.<sup>71</sup> Furthermore, the increase in daily trading volume after the expiration of lock-up periods was found to be much steeper for VC backed firms.<sup>72</sup> Brav/Gompers (2000) and Bradley et al. (2001) report similar results.<sup>73</sup> Garfinkle et al. (2002) support the general picture of a longer-term underperformance for over 180 days after the expiration of lock-up period<sup>74</sup> without finding a difference between VC and non-VC backed IPOs.

## 2.4 Derived Hypothesis

From the different theoretical explanations, we derive the following testable hypotheses:

### A. Performance-related hypotheses:

- H1: IPOs underperform seasoned stocks.
- H2: VC backed IPOs outperform other IPOs as long as VCs maintain stakes in the firm.
- H3: VC backed IPOs’ performance will converge to that of other IPOs in the long-run.
- H4a: VC backed IPOs’ prices decreases stronger around the expiration of lock-up agreements and bounce back at least in the intermediate run (price pressure hypothesis).

<sup>68</sup> Shleifer (1986) found evidence for downward sloping demand curves for new stocks in the S&P 500.

<sup>69</sup> Brav/Gompers (2000), p. 22

<sup>70</sup> See Gompers/Lerner (1998), Table 2 and Figure 1, 2, pp. 2173-2181.

<sup>71</sup> See Field/Hanka (1999), Table 3 and Table 6.

<sup>72</sup> See Field/Hanka (1999), p.480, Figure 3

<sup>73</sup> See Bradley et al. (2001), Figure 3.

<sup>74</sup> Garfinkle et al. (2002), pp. 54-57.

H4b: VC backed IPOs' prices decrease around the expiration of lock-up agreements and do not bounce back in the intermediate run (downward sloping demand curves).

**B. Non-performance-related hypotheses:**

H5: IPOs exhibit higher abnormal trading volumes around the end of lock-up agreements.

H6: The volume effect should be stronger for VC backed firms.

### 3. Data, Legal Framework and Methodology

#### 3.1 Data Selection

Our sample of IPOs on the *Neuer Markt* ranges from March 1997 to August 2001. IPO characteristics were collected from the various issue prospectuses.<sup>75</sup> Closing prices, trading volumes, the NEMAX All Share and NASDAQ composite data as well as USD-DEM (recalculated from USD-EUR after Jan 2002) to currency-adjust NASDAQ returns were drawn from Datastream. The total sample of IPOs was divided into VC and NVC backed IPOs. A company was defined as VC backed if the following criteria were met:

- a) The shareholder in question was either a full member of a recognized VC organization or listed on Venture Economics
- b) The cumulative equity stake of all financial institutions defined as VCs exceeded a hurdle of 2.5% at the time of the IPO.<sup>76</sup>

This procedure gave a total of 312 IPOs, of which 133 were defined as VC backed.<sup>77</sup> Since, by definition, the NEMAX All Share Index as a benchmark<sup>78</sup> includes the whole sample of IPOs, abnormal performance of IPOs will influence the index and result in a simultaneity bias. Hence, we preferred the NASDAQ Composite Index, which is highly correlated with the NEMAX All Share index, as a benchmark for the long-term performance study.

#### 3.2 The Relevant Rules and Regulations on *Neuer Markt*

Since the *Neuer Markt* was a privately organized trading segment, a company had to be admitted to the *Geregelter Markt* on the Frankfurt Stock exchange, too, so that IPOs and trading on *Neuer Markt* are subject to the same set of legal regulations. However, within the privately organized status of *Neuer Markt*, its sponsor, *Deutsche Boerse AG (DBAG)* enforced a stricter system of rules. For the analysis conducted here two rules are of importance: Firstly, existing shareholders had to agree to a hard lock-up period of 6 months covering all shares not issued in the IPO<sup>79</sup> with the issuing company itself being liable for the enforcement towards *DBAG*. Since September 1999, *DBAG* required the separation of free float and locked shares with two different security identification numbers to make straight sales of locked shares during the compulsory lock-up period technically impossible. Extended agreements were often negoti-

<sup>75</sup> *Verkaufsprospekt und Unternehmensbericht*.

<sup>76</sup> This was done to filter out service companies such as financial advisers that are occasionally paid in equity but do not provide VC-services. See Mackewicz (2001) for a similar procedure.

<sup>77</sup> To avoid survivorship bias we traced those companies that changed the market segment. Only a few companies were completely delisted from German Stock markets before February 2002.

<sup>78</sup> Because of *Neuer Markt's* focus on growth stocks, we felt that market indices such as the CDAX are not an appropriate benchmark in view of the different performance of growth and value stocks between 1997 and 2002.

<sup>79</sup> The expression 'selling shares' in this sense includes any action similar to sales such as derivative and similar agreements.

ated in addition to the compulsory lock-up period.<sup>80</sup> By contrast, in the US, lock-up agreements follow from an arrangement between the issuer, existing shareholders and underwriters<sup>81</sup> and premature sales are allowed subject to the underwriter's prior permission. Another difference between Germany and the US are disclosure requirements. While SEC Rule 144 restricts not only sales of primary insiders but all existing shareholders of the floated firm if shares were held for less than two years,<sup>82</sup> such restrictions do not exist in Germany. Since March 2001, primary insiders on *Neuer Markt* but not VCs were obliged to disclose their transactions in shares and related derivatives within three days. A concept similar to the 'quiet period' in the US where SEC Release No. 5180 governs the publication of a firm's and its underwriters' opinions and recommendations over a period of 25 calendar days following the IPO<sup>83</sup> does not exist in Germany. Thus, one would not expect a systematically occurring event to bias returns until the expiration of compulsory lock-up agreements.

### 3.3 Measuring Post-IPO Performance

Post-IPO performance is examined on a weekly return basis. Since different from the samples of other studies most companies with a listing on *Neuer Markt* were brought public after 1999, this paper covers only shorter time windows of 6, 12 and 18 months while other studies examined two to three years of performance.<sup>84</sup> To accommodate for the need of a sufficient number of return observations, we used weekly rather than monthly data.

Following Ritter's (1991) procedure, a benchmark-adjusted return  $AR_{i,t}$  for a given stock  $i$  in event week  $t$  was calculated as the difference between the stock's raw return  $r_{i,t}$  and the benchmark's raw return  $r_{BM,t}$  in week  $t$  with returns being calculated as simple returns between two Wednesdays<sup>85</sup>:

$$(1) \quad AR_{i,t} = r_{i,t} - r_{BM,t}.$$

Thus, the benchmark-adjustment only takes movements vis-à-vis the benchmark index into account, but does not account for the company's systematic risk. NASDAQ returns are currency-adjusted. Averaging across  $N$  stocks gives the average benchmark-adjusted return  $AR_t$ :

$$(2) \quad AR_t = \frac{1}{N} \sum_{i=1}^N AR_{i,t}.$$

$AR_t$  is the abnormal return of  $N$  stocks between two given Wednesdays after the IPO. The average cumulative abnormal return  $CAR_T$  over a time window of  $T$  trading weeks is defined as:

$$(3) \quad CAR_T = \sum_{t=1}^T AR_t.$$

A negative  $CAR$  shows underperformance of a portfolio of stocks against a benchmark.

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<sup>80</sup> See Schanz (2000), p. 360.

<sup>81</sup> See Ofek/Richardson (2000), pp. 3,4.

<sup>82</sup> See Nowak/Gropp (2001), pp. 5-7.

<sup>83</sup> See Bradley et al. (2002), pp. 3-6.

<sup>84</sup> See e.g. Ritter (1991), p. 7, van Frederikslust/van der Geest (2000), p. 9, or Loughran/Ritter (1995) who also investigate five year returns of new issues.

<sup>85</sup> The choice of Wednesdays is fairly arbitrary; however, since throughout a year fixed bank holidays include in Germany Mondays (e.g. Easter Monday) and Thursdays (e.g. Corpus Christi) with Fridays often being bridge days with low trading volume, Wednesday return are expected to result in the smallest variance bias.

Buy and hold-returns as the geometrically compounded return on a stock  $i$  or a benchmark  $BM$  over a time window from week 1 to  $T$  were calculated as:

$$(4) \quad R_{i,T} = \prod_{t=1}^T (1 + r_{i,t}) - 1 \quad \text{and} \quad R_{BM,T} = \prod_{t=1}^T (1 + r_{BM,t}) - 1.$$

On the basis of buy and hold-returns two other performance measures were constructed: Consistent with Doukas/Gonenc (2000), the difference between  $R_{i,T}$  and  $R_{BM,T}$  is calculated as the benchmark-adjusted buy and hold-return  $BAR_{i,T}$ .<sup>86</sup>

$$(5) \quad BAR_{i,T} = \prod_{t=1}^T (1 + r_{i,t}) - \prod_{t=1}^T (1 + r_{BM,t}).$$

If  $BAR_{i,T} > 0$ , stock  $i$  outperforms the benchmark. The aggregated benchmark-adjusted return  $ABAR_T$  is calculated as the equally-weighted average across a portfolio of  $N$  stocks:

$$(6) \quad ABAR_T = \frac{1}{N} \sum_{i=1}^N BAR_{i,T}.$$

The wealth relative  $WR_{i,T}$ , of a stock  $i$  is defined as the ratio of a stock  $i$ 's buy and hold-return over a benchmark's buy and hold-return over a period of  $T$  weeks:<sup>87</sup>

$$(7) \quad WR_{i,T} = \frac{1 + R_{i,T}}{1 + R_{BM,T}}$$

The individual wealth relatives are aggregated across the  $N$  stocks:

$$(8) \quad WR_T = \sum_{i=1}^N WR_{i,T}.$$

A wealth relative higher than one indicates that a portfolio of  $N$  stocks outperforms the benchmark. All three measures of underperformance, i.e.,  $CAR_{TS}$ ,  $ABAR_{TS}$  and  $WR_{TS}$  were calculated for the VC and NVC sample, both benchmarks and three time windows. The 24-week return refers to 6 months of after-market trading where the 24 (rather than 26) stems from the truncation of the first trading week to keep out the substantial initial return of *Neuer Markt* IPOs<sup>88</sup> and the intention to avoid an influence of the expiration of lock-up agreements after 6 months. Time windows of 50 (rather than 52) and 74 (rather than 76) trading weeks follow the same idea. The statistical significance of abnormal performance is tested with parametric cross-sectional t-tests for market-adjusted buy&hold returns<sup>89</sup> and CARs<sup>90</sup> and non-

<sup>86</sup> See Doukas/Gonenc (2000), pp. 11,12. We chose a different terminology than Doukas/Gonenc to avoid confusion with other IPO-studies referring to operating performance as performance of the underlying business rather than equity returns.

<sup>87</sup> See Ritter (1991), p. 8. Note that Ritter and also van Frederikslust/van der Geest (2000) first average across returns and then calculate the aggregated wealth relative  $WR_T$  on basis of aggregated returns. We calculate  $WR_T$  as the sum of the individual stocks' wealth relatives instead.

We calculate the individual wealth relatives first to obtain a cross section of wealth relatives to be able to investigate the variation and distribution of  $WR_{i,t}$ s across stocks.

<sup>88</sup> See Franzke (2001), p. 16, with an average initial return of slightly more than 60%, or Kraus (2002), Table 3 with an average initial return of just above 50%.

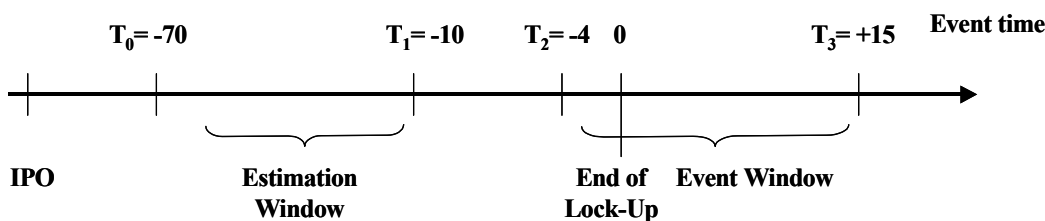
<sup>89</sup> The test statistic is calculated as  $t = AR_T \cdot \sqrt{N} / sd_T$  where  $AR_T$  refers to any aggregated return measure, be it on a raw return or a benchmark-adjusted basis.

parametric sign tests<sup>91</sup>. Secondly, we investigated whether the VC and NVC series are drawn from the same underlying distribution. The statistical significance of differences between the two samples was examined with a difference-in-means t-statistics<sup>92</sup> as well as with a non-parametric Mann-Whitney U-Test for difference-in-medians.<sup>93</sup> When more than two samples are compared, we report ANOVA F-Tests and van-der-Waerden Z-Scores.<sup>94</sup> In addition to normal confidence levels, we also indicate in the following probabilities within the 15% band.

### 3.4 The Expiration of Lock-Up Agreements in an Event Study Design

We examine the short-run market reaction around lock-up expirations in an event study design.<sup>95</sup> We define the expiration of the lock-up agreement as an event and assign the day 0 on the event time scale to the respective date. The estimation window to calculate normal returns spans from  $T_0 = -70$  days to  $T_1 = -10$ . Thereby, we exclude the usual underwriter support period of 30 trading days and the subsequent adjustment to new equilibrium prices.<sup>96</sup> Abnormal returns are calculated over an event window spanning from  $T_2 = -4$  to  $T_3 = +15$  trading days. The inclusion of the four days prior of the event allows investigating short term anticipation effects. The different time windows are shown in the timeline below.

Figure 1: Estimation and Event Window



The normal return is estimated in an OLS-Regression with the market model

$$(9) \quad r_{i,t} = \hat{\alpha}_i + \hat{\beta}_i r_{BM,t} + \varepsilon_{i,t}, \text{ for } t \in \{T_0; T_1\}.$$

where  $\hat{\alpha}_i$  and  $\hat{\beta}_i$  denote regression coefficient estimates and  $\varepsilon_{i,t}$  the residual. Both, NASDAQ Composite and NEMAX All Share Index are used as benchmarks.<sup>97</sup> The abnormal return of a

<sup>90</sup> Following Ritter (1991), p. 10, the test statistic is calculated as  $t = CAR_T \cdot \sqrt{N_T} / csd_T$  where the standard deviation of the  $CAR_T$  was calculated as  $csd_T = [t \cdot \sigma^2 + 2 \cdot (t-1) \cdot \sigma_{t,t-1}]^{\frac{1}{2}}$  with  $\sigma^2$  as the average cross sectional variance of abnormal returns over all  $T$  trading weeks (i.e.  $\sigma^2 = \frac{1}{T} \sum_{t=1}^T \sqrt{(AR_{i,t} - \overline{AR}_i)^2}$ ) and  $\sigma_{t,t-1}$  is the first-order autocovariance of the time series of  $AR_t$ 's calculated as  $\sigma_{t,t-1} = (AR_t - \overline{AR}) \cdot (AR_{t-1} - \overline{AR}) \cdot (N-1) / N$ .

<sup>91</sup> Note that, since none of the abnormal returns actually equals exactly zero, problems of zero differences do not occur here. See Campbell/Lo/MacKinlay (1997), p. 172, for an application in financial economics, and Gibbons (1985), pp. 100-102.

<sup>92</sup> See e.g. Gujarati (1995), pp. 254-263.

<sup>93</sup> For difference-in-medians statistics, the Mann-Whitney U-Test was used. The idea of this test is that, if two sub-samples are drawn from the same, unknown underlying distribution, they shall have the same sum of ranks, where an observation's rank stems from an observation's position in the combined and size-ordered sample. See Gibbons (1985), pp. 152, 153 and pp. 163-167.

<sup>94</sup> See, e.g., Büning/Trenner (1994), p. 190 for the n-sample specification.

<sup>95</sup> For further information on event studies see Campbell/Lo/MacKinlay (1997), pp. 149-180.

<sup>96</sup> See Jenkinson/Ljungqvist (2001), pp. 56, 57.

<sup>97</sup> In the following, only results based on the NEMAX All Share index will be reported since they showed by far better a fit for short run returns compared to the NASDAQ Composite. Note, that the earlier argument against the use of the NEMAX All Share Index is mitigated, since due to shorter time windows, price movements are

stock  $i$  on a day  $t$  in the event window  $AR_{i,t}$  is calculated as the difference between realized return and expected return based on the market model:

$$(10) \quad AR_{i,t} = r_{i,t} - \hat{\alpha}_i - \hat{\beta}_i r_{BM,t}, \text{ for } t \in \{T_2; T_3\}.$$

Abnormal returns are averaged across the  $N$  stocks in each sample,

$$(11) \quad AR_t = \frac{1}{N} \sum_{i=1}^N AR_{i,t}, \text{ for } t \in \{T_2; T_3\},$$

and aggregated over the event window afterwards:

$$(12) \quad CAR_T = \frac{1}{N} \sum_{t=1}^T \overline{AR}_t$$

The statistical significance of abnormal returns is tested with three different procedures.

Firstly, normal t-values were calculated. Implicitly, the use of normal t-statistics assumes the  $AR_t$ 's under  $H_0$  to be i.i.d. and normally distributed. Cross sectional dependencies are captured by the use of portfolio (sample) excess returns. However, (12) does not adjust for autocorrelation. Brown/Warner (1985) found the test-statistic to have greater power when standardizing single stock abnormal return with a stock's standard deviation in the estimation window before grouping them to portfolios. Thus,

$$(13) \quad AR'_{i,t} = AR_{i,t} / \hat{\sigma}_{T_0, T_1}(AR_{i,t})$$

Both testing procedures are parametric. To capture biases due to such stylized facts, we employ a Corrado Test as non-parametric alternative.<sup>98</sup> This test builds on the idea that under  $H_0$  the actual size rank of an observation should not cross sectionally differ significantly from the expected rank, i.e., the average rank. The Corrado test statistic  $CTS_t$  is calculated as

$$(14) \quad CTS_t = 1/N \sum_{i=1}^N Rg_i(AR_{i,t}) - [(T_3 - T_2 + 1)/2] / \sigma(Rg_t),$$

where  $Rg_t$  is defined as the rank place in ascending order of observation  $AR_{i,t}$  in the vector  $\mathbf{AR}_t$  consisting of  $AR_{i,t}$  returns.<sup>99</sup> The cross sectional standard deviation of the rank places at time  $t$ ,  $\sigma(Rg_t)$ , is calculated as:

$$(15) \quad \sigma(Rg_t) = \sqrt{\frac{1}{(T_3 - T_2)} \sum_{t=T_2}^{T_3} \left[ \frac{1}{N} \sum_{i=1}^N Rg_i(AR_{i,t}) - (T_3 - T_2 + 1)/2 \right]^2}$$

The mean daily volume during the estimation window as the normal volume is defined as<sup>100</sup>:

$$(16) \quad \mu(V_i) = \frac{1}{N} \sum_{t=T_0}^{T_1} V_{i,t}$$

The relative abnormal volume  $RAV_{i,t}$  is calculated as the deviation from the normal mean:

much smaller. In the light of better adjusted  $R^2$  and F-Tests we felt the use of the NEMAX All Share would be preferable to the NASDAQ Composite.

<sup>98</sup> See Corrado (1989), pp. 388, 389. The Corrado Test was chosen instead of the sign test because of a higher test power with skewed returns. See Campbell/Lo/MacKinlay (1997), pp. 172, 173.

<sup>99</sup> See Campbell/Lo/MacKinlay (1997), p. 172, 173. For technical reasons, we prefer to take the expected rank  $(T_2 - T_1 + 1)/2$  out of the summation in the numerator.

<sup>100</sup> See Field/Hanka (2001), p. 478.

$$(17) \quad RAV_{i,t} = [V_{i,t} / \mu(V_i)] - 1$$

The relative abnormal volume allows for cross sectional aggregation in order to compare the aggregated relative abnormal volume of a portfolio of stocks to each other. Because of the substantial variation of abnormal volume across time and stocks, we chose not to report significance tests for abnormal volume.

### 3.5 Testing for the Existence of Breakpoints

Since the expiration time differs across firms, we use a relative time scale where week 0 is the IPO week, 6 month-lock-up periods expire in week 25 etc. This relative time scale allows grouping stocks into portfolios of similar lock-up period lengths but with different expiration dates. Our first test is based on the idea that, if the expiration date represents a significant breakpoint in the abnormal return time series of IPOs, a binary variable which takes the value 1 before the expiration and 0 thereafter will capture return differences. The regression of each  $T \times 1$  vector of abnormal weekly returns  $AR_i$ <sup>101</sup> on a constant  $c$  and the corresponding lock-up period dummy variable  $D_i$  provides an estimate for the coefficient  $\gamma_i$  of the binary variable:

$$(18) \quad AR_i = c + \gamma_i \cdot D_i, \text{ for all } i = 1 \text{ to } N.^{140}$$

Furthermore, in a second pass cross sectional significance test using a two-sided parametric t-test and a non-parametric Wilcoxon Test with similar hypotheses we examine whether the  $\gamma_i$ s of the first pass time series regression are significantly different from zero across stocks. A positive dummy coefficient indicates higher abnormal returns before the lock-up period than thereafter. Since data on single securities is very noisy and regressing each stock's return series on the above-mentioned binary variable is inefficient, companies with lock-up periods of similar length were grouped to portfolios of four to five stocks.<sup>102</sup>

Secondly, we test whether the regression coefficients in

$$(19) \quad r_{i,t} = c_i + \beta_i \cdot r_{BM,t} + [\gamma_i \cdot D_{i,t}], \text{ for all } i = 1 \text{ to } N^{140}$$

are stable over time.  $D$  is a dummy variable that takes the value 1 before the expiration of the lock-up period and zero thereafter. The regression coefficient  $\gamma_i$  shows impact and significance.<sup>103</sup> As an alternative, we provide a Chow Breakpoint Test.<sup>104</sup> The null hypothesis of this test is a structural change due to the expiration of lock-up agreements in  $t_{BP}$ . The test compares the results of a pooled regression over all  $T$  observations with those of two separate regressions, one for observations 0 to  $t_{BP}$  and the other for  $t_{BP}$  to  $T$ .<sup>105</sup> Since the Chow Breakpoint Test is sensitive to violations of the presumed homoscedasticity, we test for heteroscedasticity with White heteroscedasticity tests.<sup>106</sup>

<sup>101</sup>  $AR_{i,t}$  may stem from a single share  $i$  or the  $i^{\text{th}}$  portfolio of shares.

<sup>102</sup> See for the use of portfolios in a similar context Black et al. (1972), pp. 84, 85, or Fama/MacBeth (1973), pp. 614-617. The need for a sufficient number of estimates for the second pass test limits the maximum number of stocks in each portfolio.

<sup>103</sup> See Gujarati (1970) or the summary in Greene (1997), pp. 349-359.

<sup>104</sup> See Kullback/Rosenblatt (1957), pp. 73-76 and Chow (1960), pp. 594, 595.

<sup>105</sup> The significance of the test is evaluated by comparing the impact of the imposed restrictions with an F-Test, i.e.,  $F = \frac{(RSS_{restr.} - RSS_{unrestr.})/k}{RSS_{unrestr.}/(n_1 + n_2 - 2 \cdot k)}$  where  $k$  is the number of estimated parameters (here 2),  $n_1, n_2$  are the number

of observations before and after the breakpoint and  $RSS$  the residual sum of squares of the two regressions.

<sup>106</sup> See White (1970).

## 4. Post-IPO Performance, Venture Capital Exits and Lock-Up Expiration on Germany's *Neuer Markt*

### 4.1 Descriptive Statistics

Table 1: Descriptive statistics for 312 IPOs, categorized by VC backing

Age:	Age measured since day of inception as stated in the IPO prospectus
Market Valuation:	Number of shares admitted to trading on the IPO date multiplied by the issue price
Offering size:	Number of shares issued as regular issue plus Number of shares sold in the course of greenshoe agreements, multiplied by the issue price.
Free Float (FF):	Ratio of number of shares issued as regular issue plus number of shares sold in the course of greenshoe agreements, divided by total number of shares.
Initial Return (IR):	(1 <sup>st</sup> Day Closing Price / Issue Price) - 1
PreInOwn (PostInOwn):	Inside ownership before (after) issue, where an insider is defined as a board member (" <i>Vorstand</i> " and " <i>Aufsichtsrat</i> ") or its relative.
FracCapIncr:	Ratio of number of new shares issued to total number of shares issued

	VC <sup>1</sup>	NVC <sup>1</sup>	t-Value / Z-Score <sup>2</sup>
<b>Number of firms</b>	133	182	
<b>Age (in years)</b>	11.4 <i>8</i> (11.03)	12.2 <i>10</i> (11.35)	0.605 <i>0.967</i>
<b>Market Valuation (in EUR)</b>	248,000,000 <i>120,000,000</i> (635,000,000)	338,000,000 <i>141,000,000</i> (1,020,000,000)	0.893 <i>1.771<sup>c</sup></i>
<b>Offering Size (in EUR)</b>	59,260,860 <i>41,518,772</i> (57,363,485)	82,224,079 <i>40,587,500</i> (228,000,000)	1.133 <i>0.602</i>
<b>Free Float (FF)</b>	34.5% <i>30.8%</i> (20.9%)	30.7% <i>28.7%</i> (12.0%)	2.544 <sup>a</sup> <i>2.632<sup>a</sup></i>
<b>Initial Return (IR)</b>	51.8% <i>26.5%</i> (71.4%)	53.8% <i>27.0%</i> (78.9%)	0.231 <i>0.304</i>
<b>PreInown</b>	45.6% <i>48.7%</i> (26.3%)	62.2% <i>70.3%</i> (35.9%)	4.503 <sup>a</sup> <i>4.741<sup>a</sup></i>
<b>PostInown</b>	33.3% <i>34.3%</i> (19.6%)	43.6% <i>50.5%</i> (25.6%)	3.860 <sup>a</sup> <i>4.010<sup>a</sup></i>
<b>FracCapIncr</b>	81.5% <i>84.2%</i> (18.3%)	86.6% <i>92.5%</i> (16.5%)	2.544 <sup>a</sup> <i>2.632<sup>a</sup></i>

<sup>1</sup> Top figure of each series is the mean; medians are shown in italics and standard deviation in parenthesis

<sup>2</sup> Top figure gives t-Value for difference-in-means comparison; test statistic of Mann-Whitney U-Test for difference-in-medians comparison in italics

<sup>a</sup> significant on a 1%-Level

<sup>b</sup> significant on a 5%-Level

<sup>c</sup> significant on a 10%-Level

Table 1 provides descriptive statistics for the two samples. VC backed companies differ from non-VC backed companies in some respects. VC backed firms are on average smaller than NVC backed firms on a mean<sup>107</sup> and median basis. VC and NVC firms issued similar amounts of, on average, EUR 40 million in the course of the IPO. The combination of lower market

<sup>107</sup> Note that the mean of the NVC sample is upwardly biased by the floatation of spin-offs. T-online AG, e.g., as the company with the highest IPO market valuation was valued with over EUR 12 billion at the time of the IPO.

valuations and similar offer sizes explains the significantly higher initial free float of VC backed firms.<sup>108</sup> Also, NVC firms are financed to a significantly greater extent by insiders, i.e., board members and their relatives. In return, non-VC backed firms see more shares locked in.<sup>109</sup> From the differences in the percentage of new shares in the issue (*FracCapIncr*), we conclude that existing shareholders of VC backed firms sell more shares in the primary market. However, the relative reduction in inside (managerial) ownership (i.e., the difference between *PreInOwn* and *PostInOwn*) is lower for VC backed firms. Thus, NVC insiders sell more shares during the IPO than their counterparts in VC backed firms. However, since *FracCapIncr* is lower for VC backed firms, other existing shareholders have to sell more shares in VC backed IPOs than in non-VC backed IPOs. Hence, as by definition the samples differ in VC backing, VCs tend to sell shares in the IPO while managers are prevented from reducing their holdings relative to NVC managers.<sup>110</sup> The additional sales, however, do not have a significant impact on initial returns, so that both samples appear to be similarly underpriced.<sup>111</sup>

Table 2 provides further insight into the exit behavior of VCs during the IPO. In over 70 percent of the VC backed IPOs, VCs partially exited. On average, VCs reduced their holdings by 5 percentage points on a diluted basis. Often VCs provided shares as a greenshoe. However, VCs almost never ever exited completely in the IPO.<sup>112</sup>

*Table 2: Pre- and Post-IPO Holdings of Venture Capitalists*

The sample is 133 VC backed IPOs on *Neuer Markt*.

VCPreOwn	Aggregated ownership of <b>all</b> VCs before IPO sales <b>and</b> dilution
VCPostOwn	Aggregated ownership of <b>all</b> VCs after IPO sales <b>and</b> dilution (including sales subject to the exercise of overallocation options)
VCExit	Binary variable that takes the value “1” if the absolute number of shares held by VCs was reduced within the IPO, i.e., shares were sold; “0” otherwise
VCFracSold	% of sold shares relative to total number of outstanding shares after the IPO, i.e. after dilution (including sales under overallocation option agreements)

	VCPreOwn	VCPostOwn	VC Exit	VCFracSold
<b>Mean</b>	31.8%	18.8%	71.3%	4.5%
<b>Median</b>	28.5%	15.2%	100.0%	2.6%
<b>STD</b>	20.6%	13.5%		

With an average post-IPO holdings of 19 percent, post-IPO performance does matter for VCs in this sample which confirms evidence from Germany and other countries.<sup>113</sup> However, the relative ownership level of VCs is more reduced by dilution than by actual sales of shares.

Another influence factor on post-IPO performance is the length of the lock-up period:

<sup>108</sup> The average issue prices of EUR 25.31 and EUR 25.52 and the median issue prices of EUR 21 and EUR 22 respectively do not significantly differ between the two groups.

<sup>109</sup> Recall that the rules of the *Neuer Markt's* required a compulsory 6 month lock-up period for all share not issued in the IPO.

<sup>110</sup> This interpretation is in line with the observations in Burghof/Fischer (2002), Table 7, and clearly distinct from Mayer's (2001), p.1049, statement that VCs increase their investment with the IPO.

<sup>111</sup> On underpricing at the *Neuer Markt* see Franzke (2001), Table 6, p. 16, or Kraus (2002), Table 3, p. 14.

<sup>112</sup> The exception is BV Beteiligungs GmbH & Co KG who sold its entire holdings in Prout AG in the IPO.

<sup>113</sup> See for the US Megginson/Weiss (1991) Table 9, p. 900, with a post IPO ownership of VC of 26%, or Tin/Smith (1998), Table 3, p. 250, with 20.7%. Hamao et al. (2000) Table 3 provide Japanese evidence. On Germany, see Mayer (2001), p. 1049, with venture capitalists pre IPO ownership of 32% and post IPO ownership of 20.04%, or Burghof/Fischer, Table 6, with 33,5% and 18,9% respectively.

*Table 3: Composition of VC and NVC Samples by Length of Lock-Up Agreements*

The sample is 293 IPOs on *Neuer Markt*. Lock-Up figures include commitments towards underwriters if more than 95% of initially locked shares are covered by the agreement. Data on total lock-up agreements were not available for 19 IPOs.

	<b>N</b>	<b>Mean</b>	<b>6</b>	<b>&lt;12, not 6</b>	<b>12</b>	<b>&gt;12</b>
<b>VC</b>	123	8.3	77	6	33	7
<b>NVC</b>	170	10.7	63	0	89	18

Remarkably, shareholders of non-VC backed IPOs were willing (or forced) to commit themselves to longer lock-up periods in more than 63% of the cases, the respective number being 32% for VC backed IPOs only. This is consistent with Nowak/Gropp (2002), who report that only 45% of the shareholders of IPOs until March 1999 committed themselves to additional lock-up periods and declare that VCs were reluctant to do so. Brav/Gompers (2000) also found VC backed IPOs in the US to have shorter lock-up periods.<sup>114</sup>

The industry distribution<sup>115</sup> as well as the timing of IPOs, i.e. the ability of identifying windows of opportunities when floating companies, were identified in the literature as further influence factors. However, in the case of our analysis, we did find neither of the two to have additional explanatory power.<sup>116</sup> Offer characteristics may thus partly explain post-IPO performance and have to be considered in robustness tests.

## 4.2 Post-IPO Performance on Germany's *Neuer Markt*

### 4.2.1 Buy and Hold>Returns, Wealth Relatives and Cumulative Returns

Table 4 displays the (abnormal) return measures for the different samples and time windows and the respective benchmarks. All three measures are highly skewed due to outliers, i.e. companies that performed very well after the IPO. Therefore, the following analysis puts a particular emphasis on medians and related non-parametric measures.

Long-term investors lost money with *Neuer Markt* IPOs between 1997-2002 if they bought shares in the immediate after-market. E.g., the investor in the median IPO achieved a significant negative absolute return of -34% over 50 trading weeks (Panel B). Raw return medians are negative for both sub samples, too. However, following the positive skewness mentioned earlier, raw return means are positive. Consequently, an investor who invested equal amounts in all IPOs and did not rebalance his portfolio achieved a positive absolute return due to some strong outperformers.<sup>117</sup> Interestingly, the distribution of post-IPO returns of growth stocks at *Neuer Markt* is thus similar to the typical return distribution of VC portfolios.<sup>118</sup> On a relative basis, the median IPO significantly underperformed both NASDAQ Composite and the NE-MAX All Share Index. The median IPO's wealth equivalent fell from 86 percent after 24 weeks to 67 percent after 50 weeks relative to an investment in the NASDAQ composite. The striking differences between means and medians also hold for benchmark-adjusted returns.

<sup>114</sup> See Brav/Gompers (2000), pp. 13, 14 and Table 1, Panel D.

<sup>115</sup> See Ritter (1991), p. 18 and Khurshed et al. (1999), Table 8.

<sup>116</sup> In order to keep this paper to a normal length, we decided not to report these results, however, we, of course, provide the interested reader with the results if needed.

<sup>117</sup> Doukas/Gonenc's (2000), Table 2, 1<sup>st</sup> column, point to a similar pattern.

<sup>118</sup> See e.g. Cochrane (2000) or Bygrave/Timmons (1992).

While the median IPO underperformed both benchmarks over all three time windows, a portfolio of equally-weighted IPOs outperformed the index.

Table 4: 24, 50 and 74 trading weeks IPO returns, benchmark-adjusted B&H Returns and aggregated Wealth Equivalents

The sample is a maximum of 312 IPOs on *Neuer Markt*, partly categorized by VC backing. For longer return intervals some firms are dropped because of too short time intervals between the IPO and Feb 2002.

	N	Raw Return		ABAR NASDAQ		WR NASDAQ		ABAR NEMAX		WR NEMAX	
		Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
<b>Panel A: 24 Trading weeks</b>											
<b>All IPOs</b>	312	0.3558 <sup>a</sup> (3.8538)	-0.1845 <sup>a</sup> [3.4534]	0.2720 <sup>a</sup> (3.1829)	-0.1472 <sup>a</sup> [2.5476]	1.1751 <sup>a</sup> (2.6539)	0.8620 <sup>a</sup> [2.5476]	0.2953 <sup>a</sup> (3.8354)	-0.0504 <sup>c</sup> [1.7550]	1.2127 <sup>a</sup> (4.4413)	0.9400 <sup>c</sup> [1.7550]
<b>VC backed IPOs</b>	133	0.4031 <sup>a</sup> (3.1361)	-0.1789 <sup>b</sup> [2.0811]	0.3150 <sup>a</sup> (2.8046)	-0.0805 [1.0405]	1.1881 <sup>a</sup> (2.3550)	0.9255 [1.0405]	0.2942 <sup>a</sup> (3.0201)	-0.0636 [0.5203]	1.1995 <sup>a</sup> (3.1101)	0.9724 [0.5203]
<b>Non-VC backed IPOs</b>	179	0.3207 <sup>a</sup> (2.4641)	-0.1849 <sup>a</sup> [2.7733]	0.2401 <sup>c</sup> (1.9568)	-0.1607 <sup>b</sup> [2.3235]	1.1654 (1.6883)	0.8207 <sup>b</sup> [2.3235]	0.2962 <sup>a</sup> (2.6262)	-0.0474 <sup>c</sup> [1.7239]	1.2226 <sup>a</sup> (3.2539)	0.9284 <sup>b</sup> [1.7239]
<b>Difference VC vs. NVC</b>		0.0824 (0.6640)	0.0060 [0.7418]	0.0749 (0.6793)	0.0802 [0.4448]	0.0227 (0.1537)	0.1049 [0.6469]	-0.0021 (0.9751)	-0.0163 [0.6061]	-0.0231 (0.2529)	0.0440 [0.6061]
<b>Panel B: 50 Trading weeks</b>											
<b>All IPOs</b>	306	0.3113 <sup>b</sup> (2.2812)	-0.3402 <sup>a</sup> [3.9445]	0.1853 (1.4203)	-0.2635 <sup>a</sup> [6.5741]	1.0739 (0.6612)	0.6661 <sup>a</sup> [6.5741]	0.2531 <sup>b</sup> (2.0296)	-0.0567 [1.5435]	1.2633 <sup>a</sup> (3.3777)	0.8763 [1.5435]
<b>VC backed IPOs</b>	129	0.2647 <sup>b</sup> (1.9630)	-0.3785 <sup>b</sup> [2.2892]	0.1344 (1.1257)	-0.2496 <sup>a</sup> [3.5218]	1.0239 (0.2630)	0.6663 [0.8805]	0.1771 (1.5564)	-0.0918 [0.8805]	1.2537 <sup>a</sup> (2.3258)	0.8629 [0.8805]
<b>Non-VC backed IPOs</b>	177	0.3451 (1.6198)	-0.3279 <sup>a</sup> [3.0905]	0.2223 (1.1000)	-0.2812 <sup>a</sup> [5.5026]	1.1104 (0.6287)	0.6582 [1.1307]	0.3086 (1.5780)	-0.0495 [1.1307]	1.2704 <sup>a</sup> (2.5148)	0.8841 [1.1307]
<b>Difference VC vs. NVC</b>		-0.0804 (0.6640)	-0.0506 [0.7418]	-0.0879 (0.7179)	0.0315 [0.6432]	-0.0864 (0.6893)	0.0081 [0.8960]	-0.1315 (0.5841)	-0.0423 [0.9251]	-0.0168 (0.8897)	-0.0212 [0.7629]
<b>Panel C: 74 Trading weeks</b>											
<b>All IPOs</b>	278	0.3649 (0.9722)	-0.6218 <sup>a</sup> [8.8165]	0.2724 (0.7371)	-0.3830 <sup>a</sup> [9.5362]	0.9804 (-0.0901)	0.3906 <sup>a</sup> [9.5362]	0.4508 (1.2551)	-0.1082 <sup>a</sup> [5.2179]	1.2205 <sup>c</sup> (1.8733)	0.6562 <sup>a</sup> [5.2179]
<b>VC backed IPOs</b>	119	0.1726 (0.7597)	-0.6384 <sup>a</sup> [5.8669]	0.0755 (0.3702)	-0.3802 <sup>a</sup> [5.5002]	0.8319 (1.3645)	0.3553 <sup>a</sup> [5.5002]	0.1979 (1.0664)	-0.1056 <sup>a</sup> [3.4835]	1.0813 (0.7805)	0.5853 <sup>a</sup> [3.4835]
<b>Non-VC backed IPOs</b>	158	0.5173 (0.8101)	-0.5462 <sup>a</sup> [6.4440]	0.4282 (0.6769)	-0.3811 <sup>a</sup> [7.7169]	1.0974 (0.2623)	0.4425 <sup>a</sup> [7.7169]	0.6479 (1.0507)	-0.1082 <sup>a</sup> [3.7391]	1.3317 <sup>c</sup> (1.7324)	0.6667 <sup>a</sup> [3.7391]
<b>Difference VC vs. NVC</b>		-0.3447 (0.6514)	-0.0921 [0.7523]	-0.3527 (0.4701)	0.0009 [0.0417]	-0.2654 (0.6016)	-0.0872 [0.9689]	-0.4500 (0.6173)	0.0026 [0.1796]	-0.2504 (1.0497)	-0.0813 [0.1796]

Absolute value of normal t-statistics with  $H_0: X=0$  ( $H_1: X=1$  for Wealth Equivalents) in parenthesis; absolute value of test-statistic of sign test in brackets. For difference of VC vs. NVC, absolute value of t-statistic for difference-in-means in parenthesis, test-statistic of Mann-Whitney difference in medians test in brackets

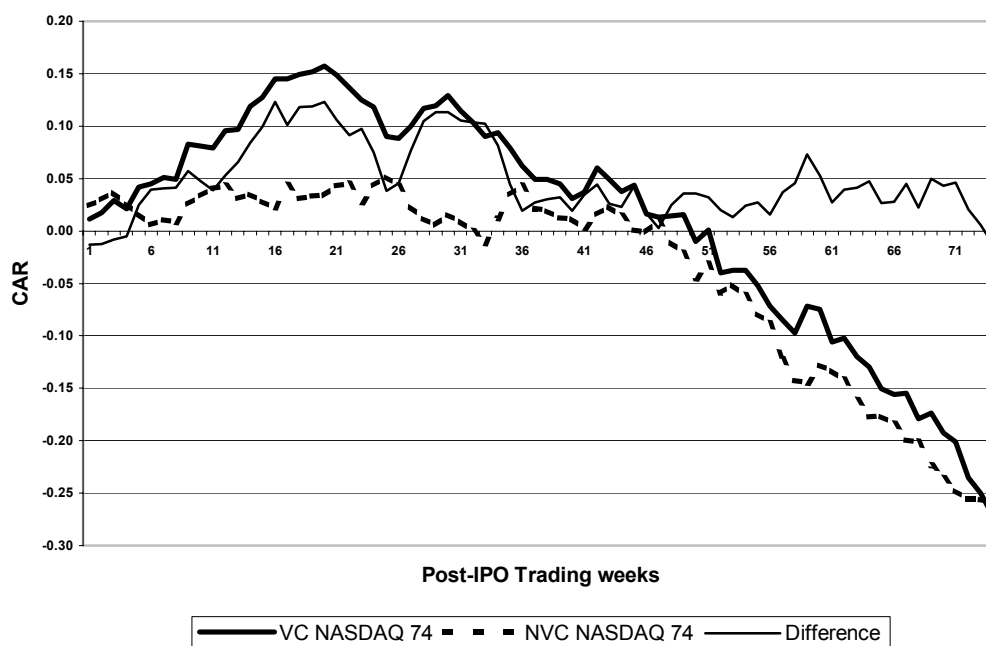
- <sup>a</sup> significant on a 1%-Level
- <sup>b</sup> significant on a 5%-Level
- <sup>c</sup> significant on a 10%-Level

The same holds for the two sub samples. Hence, consistent with hypothesis H1, the average IPO at *Neuer Markt* underperformed more seasoned stocks in the longer run of 1.5 years. The development of the  $CAR_{7T}$  over time is shown in Figure 2.<sup>119</sup> VC backed IPOs outperform the index significantly for up to 20 weeks with a maximum  $CAR$  of over 15%. Weekly abnormal returns of the VC portfolio, however, become significantly negative for trading weeks 21 to 25, peaking in the 25<sup>th</sup> week with an abnormal return of -4.6%.  $CAR$ -performance of VC backed IPOs decrease nearly constantly after the 25<sup>th</sup> week and become significantly negative after around 70 trading weeks. Non-VC backed IPOs show a lower short-run outperformance of maximal 5 percent. After around one year of trading, non-VC backed firms also start underperforming the benchmark (significant from week 65). Hence, both groups of firms under-

<sup>119</sup> The abnormal returns  $AR_T$  against the NASDAQ Composite for up to 74 weeks after the IPO are reported in Table 12 in the appendix.

perform the benchmark in the longer, run however. With their run-up after the IPO, VC backed firms outperform their non-VC backed counterparts in the intermediate run.<sup>120 121</sup>

Figure 2: Cumulative abnormal returns of VC and NVC sample against NASDAQ Composite Index over 74 trading weeks



Note, that all post-IPO holdings of old shareholders are subject to a 6-month compulsory and possibly an additional non-compulsory lock-up period. However, VCs are very reluctant to agree to longer lock-up periods while owners of NVC IPOs tend to commit themselves to longer lock-up periods of usually 12 months (see Table 3). From Figure 2 above we get that VC backed IPOs start to underperform the benchmark after 25 weeks (i.e., 6 months of trading) and non-VC backed IPOs underperform after 50 weeks (i.e., one year of trading). Consistent with hypotheses H3 and H4, the earlier expiration of lock-up agreements and the presumed subsequent exit of VCs may provide explanations for both, the short run outperformance of VC backed IPOs and the subsequent long-run convergence with the performance of non-VC backed IPOs and thus represent a breakpoint in the time series of post-IPO returns.<sup>122</sup>

In the following, we use robustness tests to ensure that these effects are caused by VC backing and not by potential performance drivers as identified above.

#### 4.2.2 Robustness Tests for Post-IPO Performance

Different from Brav et. al. (2000), who find, that “once IPO firms are matched to size and book-to-market portfolios, which are themselves free of issuing firms, there is no underperformance”<sup>168</sup>, we did not employ a French/Fama (1992) type three factor model. The construction of such portfolios would with a concentration on high-tech stocks and a new stock

<sup>120</sup> This is line with Bradley et al. (2000), Table 7, who found that VC backed IPOs with a return of 29.4% returns after 180 days performed significantly better than non-VC backed IPOs that show a 23.97% return in the short run. Bradley et al. do not provide any indication of the long run performance of their VC and NVC sample.

<sup>121</sup> Table 4 provides the parametric and non-parametric test statistics for the performance differential on basis of buy and hold-returns and found the difference to be insignificant. However, because of the cross sectional variance of returns we are reluctant to focus on these measures.

market segment result in a survivorship bias. Matched portfolios of seasoned stocks listed more than 5 years ago would not capture the severe negative return of firms in the control group with a delisting within five years after the IPO. Furthermore, since the *Neuer Markt* was founded in 1997, we lack a sufficient number of listed high-tech companies. Thus, controlling for size in a way similar to Brav/Gompers (1997) was not feasible at this stage.

Table 5: Post-IPO Performance by Size Quartile Portfolios

312 IPOs are grouped to four quartile size portfolios and subsequently split into VC backed and non-VC backed. Size is measured as number of shares admitted to trading on the IPO date times issue price, i.e. as IPO market valuation.

	Q1	Q2	Q3	Q4	Test <sup>1</sup>	Q1	Q2	Q3	Q4	Test <sup>1</sup>
	<b>Panel A1: NASDAQ, 24 trading weeks</b>					<b>Panel A2: NEMAX, 24 trading weeks</b>				
<b>VC Sample</b>	-0.065 <i>-0.301</i>	0.034 <i>-0.271</i>	0.228 <i>0.081</i>	0.348 <i>0.316</i>	2.023 <sup>d</sup> <i>6.385<sup>c</sup></i>	-0.004 <i>-0.126</i>	0.166 <i>-0.013</i>	0.253 <i>0.193</i>	0.375 <i>0.264</i>	2.190 <sup>d</sup> <i>7.487<sup>c</sup></i>
<b>NVC Sample</b>	0.260 <i>-0.052</i>	0.072 <i>0.015</i>	-0.071 <i>-0.272</i>	-0.041 <i>-0.022</i>	1.905 <sup>d</sup> <i>4.562</i>	0.283 <i>0.121</i>	0.160 <i>0.047</i>	0.062 <i>-0.103</i>	0.118 <i>0.000</i>	0.952 <i>2.168</i>
<b>Difference Test<sup>2</sup></b>	1.907 <sup>c</sup> <i>3.997<sup>b</sup></i>	0.211 <i>0.337</i>	1.779 <sup>c</sup> <i>3.678<sup>c</sup></i>	2.566 <sup>b</sup> <i>5.044<sup>b</sup></i>		1.971 <sup>b</sup> <i>3.336<sup>c</sup></i>	0.040 <i>0.058</i>	1.399 <i>1.875</i>	1.792 <sup>c</sup> <i>3.710<sup>b</sup></i>	
<b>Total Sample</b>	0.098 <i>-0.087</i>	0.054 <i>-0.064</i>	0.042 <i>-0.080</i>	0.105 <i>0.083</i>	0.140 <i>0.930</i>	0.139 <i>-0.015</i>	0.163 <i>0.033</i>	0.134 <i>-0.011</i>	0.214 <i>0.051</i>	0.263 <i>1.067</i>
	<b>Panel B1: NASDAQ, 50 trading weeks</b>					<b>Panel B2: NEMAX, 50 trading weeks</b>				
<b>VC Sample</b>	-0.248 <i>-0.532</i>	0.204 <i>0.102</i>	-0.141 <i>-0.381</i>	0.162 <i>0.194</i>	1.926 <sup>d</sup> <i>5.260<sup>d</sup></i>	-0.113 <i>-0.065</i>	0.530 <i>0.651</i>	0.031 <i>-0.079</i>	0.378 <i>0.499</i>	4.116 <sup>b</sup> <i>11.417<sup>a</sup></i>
<b>NVC Sample</b>	0.078 <i>-0.141</i>	-0.025 <i>-0.121</i>	-0.034 <i>-0.121</i>	-0.176 <i>-0.262</i>	0.624 <i>1.776</i>	0.217 <i>0.155</i>	0.198 <i>0.240</i>	0.236 <i>0.204</i>	0.095 <i>0.010</i>	0.284 <i>1.209</i>
<b>Difference Test<sup>2</sup></b>	1.499 <sup>d</sup> <i>2.092<sup>d</sup></i>	1.024 <i>0.599</i>	0.532 <i>0.145</i>	1.733 <sup>c</sup> <i>2.624<sup>c</sup></i>		1.696 <sup>c</sup> <i>2.858<sup>c</sup></i>	1.643 <sup>d</sup> <i>2.659<sup>c</sup></i>	1.176 <i>1.387</i>	1.404 <i>2.081</i>	
<b>Total Sample</b>	-0.080 <i>-0.151</i>	0.079 <i>-0.046</i>	-0.074 <i>-0.273</i>	-0.049 <i>-0.021</i>	0.523 <i>1.772</i>	0.071 <i>0.110</i>	0.342 <i>0.372</i>	0.136 <i>0.083</i>	0.202 <i>0.245</i>	1.605 <i>4.953</i>
	<b>Panel C1: NASDAQ, 74 trading weeks</b>					<b>Panel C2: NEMAX, 74 trading weeks</b>				
<b>VC Sample</b>	-0.455 <i>-0.475</i>	-0.180 <i>-0.458</i>	-0.310 <i>-0.464</i>	-0.116 <i>0.053</i>	0.549 <i>1.660</i>	-0.203 <i>-0.487</i>	0.337 <i>0.375</i>	0.059 <i>0.144</i>	0.261 <i>0.145</i>	1.723 <i>5.021</i>
<b>NVC Sample</b>	-0.086 <i>-0.134</i>	-0.163 <i>-0.145</i>	-0.324 <i>-0.478</i>	-0.412 <i>-0.418</i>	0.834 <i>2.341</i>	0.082 <i>0.076</i>	0.293 <i>0.307</i>	0.141 <i>0.075</i>	0.155 <i>0.011</i>	0.326 <i>1.191</i>
<b>Difference Test<sup>2</sup></b>	1.562 <sup>c</sup> <i>1.228</i>	0.063 <i>0.040</i>	0.061 <i>0.064</i>	1.740 <sup>c</sup> <i>1.647</i>		1.153 <i>1.085</i>	0.176 <i>0.004</i>	0.352 <i>0.063</i>	0.445 <i>0.314</i>	
<b>Total Sample</b>	-0.270 <i>-0.272</i>	-0.170 <i>-0.260</i>	-0.318 <i>-0.464</i>	-0.301 <i>-0.366</i>	0.275 <i>0.614</i>	-0.060 <i>-0.085</i>	0.313 <i>0.307</i>	0.108 <i>0.117</i>	0.195 <i>0.099</i>	1.725 <i>5.552<sup>d</sup></i>

First row for each section gives means; medians in italics

<sup>1</sup> Upper figure : value of ANOVA F-Test for difference-in-means between quartile returns. Lower figure: Z-Score of van der Waerden (Normal Score) Test for difference-in-medians between VC, NVC or total quartiles, respectively.

<sup>2</sup> Upper row: t-value of difference-in-means test between VC and NVC quartile return. Lower row: Z-Score of van der Waerden (Normal Score) Test for difference-in-medians between VC and NVC quartile.

#### Panel D: Distribution of Firms over size quartiles

	size	24 weeks		50 weeks		74 weeks	
		VC	NVC	VC	NVC	VC	NVC
<b>Q1</b>	<b>&lt;83.1</b>	39	39	37	39	33	33
<b>Q2</b>	<b>&lt;131.9</b>	35	42	35	42	32	40
<b>Q3</b>	<b>&lt;255.4</b>	29	48	28	48	27	41
<b>Q4</b>	<b>&gt;255.4</b>	30	50	29	48	27	45

<sup>a</sup> significant on a 1%-Level

<sup>b</sup> significant on a 5%-Level

<sup>c</sup> significant on a 10%-Level

<sup>d</sup> significant on a 15%-Level

<sup>122</sup> A plot of this pattern with a combined sample of VC and NVC IPOs with similar lock-up lengths would be similar to Garfinkle et al.'s (2002)' Exhibit 8 and 9.

However, the descriptive statistics in Table 1 show higher market valuations for NVC firms. To control for a potential size effect, size portfolios were constructed for the total sample and the two sub-samples by dividing the total sample into four quartile portfolios. Subsequently, each quartile portfolio was again split into a VC and an NVC sub-sample. Thus, three sets of size quartile portfolios were obtained.

The results in Table 5 reveal two interesting facts: Firstly, size measured as IPO valuation seems to explain at least partly post-IPO returns of VC backed firms in the short and intermediate run (24 and 50 weeks). The reported F-Tests and van der Waerden Z-Scores signal significant differences amongst the VC quartile portfolios. Top quartile stocks outperform their lowest quartile counterparts and in most cases portfolio returns are increasing in size. However, this does not hold for non-VC backed firms. Secondly, the earlier mentioned difference between VC and NVC sample (Figure 2) is partly caused by size effects. Although small VC backed IPOs appear to underperform their non-VC backed counterparts, top quartile VC backed IPOs outperform the NVC sample even stronger.<sup>123</sup> Thus, outperformance of VC backed firms in the intermediate run may partly be explained by better performance of bigger VC backed firms relative to *all* other firms, VC backed and non-VC backed.

Hence, a firm's market valuation may have explanatory power for the post-IPO performance pattern. Explanations for these results may take different routes. Firstly, big firms are more often backed by consortia of VCs. This may lead to higher institutional attention and ownership.<sup>124</sup> Furthermore, if VCs that constantly finance big firms maintain established links to highly reputable underwriters, large VC backed IPOs profit from the underwriters' strong reputation.<sup>125</sup> This idea as well as underwriter reputation as an independent explanation for long-run performance<sup>126</sup> as explained in section 2.2.1 will be addressed in the following.

Interrelations between VC backing and underwriter reputation require a simultaneous examination of the performance impact of both. We measure underwriter reputation as the relative market share of a group of lead underwriters in the IPO market (Simon-Measure (*SM*)).<sup>127</sup> The *SM* is constructed with IPOs on *Neuer Markt* only to control for differences in IPOs of young firms and established companies.<sup>128</sup> From 47 identified underwriters high reputation ranks are assigned to national top tiers such as Dresdner Bank or Deutsche Bank and to international premium players such as Goldman Sachs or Morgan Stanley.<sup>129</sup> There are, however, three caveats. Firstly, *SM* assumes reputation to be stable over time. Secondly, it essentially denotes with whom issuers choose to go public, i.e., it measures reputation from an issuer's point of view. Thirdly, *SM* is systematically downward biased for market entrants with reputation gained in other markets. To control for these shortcomings, we develop a second measure. In Euromoney's annual poll of polls for underwriting each bank is assigned a rank based on surveys amongst European institutional investors. To calculate a Euromoney

<sup>123</sup> In a way, these results are consistent with Brav/Gompers' (1997) findings that underperformance stems primarily from small, non-VC backed firms.

<sup>124</sup> Recall the argumentation of Section 2.2.2 with the interaction of VC backing and institutional ownership.

<sup>125</sup> See Megginson/Weiss (1991) who found VC backed IPOs to have underwriters with a higher reputation.

<sup>126</sup> See Carter et al. (1998) and Doukas/Gonenc (2000), pp. 1-8.

<sup>127</sup> In cases of more than one lead underwriter, credit was evenly given to each underwriter's market share. We will refer to this measure as Simon-Measure (*SM*) following Simon (1990). Doukas/Gonenc's (2000) SDC-measure is based on a similar idea. A reputation measure in the spirit of Carter/Manaster (1990) is not applicable to German IPOs as IPO syndicates are much smaller than in the US and tombstones are often not available.

<sup>128</sup> Furthermore, offering sizes on *Neuer Markt* are on average much smaller than in other market segments, so that the consideration of IPOs in other segments of the stock market would result in a bias towards banks targeting IPOs of well-established companies.

<sup>129</sup> See Table 13 in the appendix.

Measure (*EM*), the ranking is reversed and normalized to the interval (0, 1). Thus, the bank with the highest reputation receives the rank value 1, banks without listing the rank value 0. Time-varying reputation is captured by using the 2000 poll of polls for IPOs prior to 2000 and the 2001 poll of polls for IPOs thereafter. For both measures we set cut off levels to distinguish between high and low reputation.<sup>130</sup>

Table 6: Post-IPO Performance categorized by Underwriter Reputation

VC and NVC sample are divided into two portfolios each based on IPOs underwritten by banks with high reputation (VC/HR and NVC/HR) and low reputation, respectively (VC/LR and NVC/LR).

<i>Euromoney Measure (EM)</i>				<i>Simon Measure (SM)</i>			
		<i>NVC/HR</i>	<i>VC/LR</i>			<i>NVC/HR</i>	<i>VC/LR</i>
<b>Panel A1: 24 trading weeks, CAR NASDAQ</b>							
		49	100			86	77
<i>VC/HR</i>	33	(0.4312;0.1004) [0.3210;-0.0643] {2.118 <sup>b</sup> ;2.156 <sup>b</sup> }	(0.4312;0.0146) [0.3210;-0.2646] {2.7691 <sup>a</sup> ;3.0292 <sup>a</sup> }	56	(0.1721;0.0299) [0.1446;-0.1319] {1.135;1.0916}	(0.1721;0.0787) [0.1446;-0.1701] {0.691;0.854}	
<i>NVC/LR</i>	130	(0.0214;0.1004) [-0.0666;-0.0643] {0.661;0.836}	(0.0214;0.0146) [-0.0666;-0.2646] {0.069;0.433}	93	(0.0552;0.0299) [-0.0467;-0.1319] {0.236;0.368}	(0.0552;0.0787) [-0.0467;-0.1701] {0.205;0.232}	
<b>Panel B1: 50 trading weeks, CAR NASDAQ</b>							
		48	96			85	77
<i>VC/HR</i>	33	(0.2199;-0.0335) [0.1935;-0.1571] {1.255;1.369}	(0.2199;-0.0888) [0.1936;-0.1620] {1.634 <sup>d</sup> ;1.854 <sup>c</sup> }	56	(0.0406;-0.0402) [0.1473;-0.1408] {0.527;0.649}	(0.0406;-0.0474) [0.1473;-0.0528] {0.523;0.645}	
<i>NVC/LR</i>	129	(-0.0500;-0.0335) [-0.1301;-0.1571] {0.112;0.021}	(-0.0501;-0.0888) [-0.1301;-0.1620] {0.318;0.587}	92	(-0.0506;-0.0402) [-0.1339;-0.1408] {0.079;0.204}	(-0.0506;-0.0474) [-0.1339;-0.0528] {0.022;0.079}	
<b>Panel C1: 74 trading weeks, CAR NASDAQ</b>							
		46	87			80	74
<i>VC/HR</i>	32	(-0.0409;-0.2152) [0.0669;-0.1434] {0.761;0.747}	(-0.0409;-0.3557) [0.0669;-0.4749] {1.370;1.585 <sup>d</sup> }	55	(-0.3214;-0.3074) [-0.5293;-0.4501] {0.077;0.314}	(-0.3214;-0.2319) [-0.5293;-0.3715] {0.432;0.496}	
<i>NVC/LR</i>	113	(-0.2765;-0.2152) [-0.3054;-0.1434] {0.345;0.526}	(-0.2765;-0.3557) [-0.3054;-0.4749] {0.514;0.853}	79	(-0.2095;-0.3074) [-0.1339;-0.4501] {0.607;0.900}	(-0.2095;-0.2319) [-0.1339;-0.3715] {0.124;0.134}	

The first figure in each bracket is referring to the sample as labelled at the beginning of each row; the second figure as labelled at the top of each column. Mean returns are given in parenthesis, median returns in square brackets. The first figure in curly brackets gives t-statistic of difference-in-means test, the second figures gives result of Mann-Whitney U-Test for difference-in-medians.

The number of firms in each portfolio is provided in the first row / column in each panel.

<sup>a</sup> significant on a 1%-Level

<sup>b</sup> significant on a 5%-Level

<sup>c</sup> significant on a 10%-Level

<sup>d</sup> significant on a 15%-Level

High Reputation is defined as:

Euromoney Measure: Rank value > 0.9

Simon Measure: Market share of lead underwriter > 5%

<sup>130</sup> See for a similar procedure Doukas/Gonenc (2000), appendix, Table 3. Table 6 displays the most contrary pairs (e.g. VC/HR and NVC/LR) on one axis to disentangle the interrelated effects more clearly. In Table 6, VC-effects become apparent with significance on the axis from the top left to the right bottom box, whereas significance on the axis from the left bottom to the top right pair of portfolios shows reputation effects.

Table 6 displays the results. VC backed IPOs with top underwriters perform better than VC backed IPOs with low EM reputation underwriters in the intermediate run.<sup>131</sup> Using SM reputation instead of EM does mitigate the differences so that *VC/HR* firms perform only insignificantly better than *VC/LR* firms. Reputation does not seem to influence the aftermarket performance of non-VC backed firms. Furthermore, VC backing matters within the group of IPOs with top underwriters, but not for firms with low reputation underwriters. The use of NEMAX adjusted returns instead of NASDAQ adjusted return also mitigates the pattern.<sup>132</sup>

How can the slightly superior performance of the *VC/HR* portfolio when using EM be explained? The EM essentially assesses institutional investors opinion about underwriters. Field (1995) shows that IPOs with larger institutional shareholdings experienced superior long-run performance relative to matching firms.<sup>133</sup> Institutional investors should prefer IPOs underwritten by banks they esteem. Thus, on average, institutional shareholdings and performance should be higher for these IPOs. However, taken this argument for granted, it remains to explain why IPOs with top underwriters only perform better if they are VC backed? Megginson/Weiss (1991) outline that institutional ownership is significantly higher for VC backed IPOs.<sup>134</sup> Because institutional investors can invest in both public equity markets and VC funds, informational asymmetries are mitigated and institutional investors are less reluctant to invest in IPOs of VC backed companies.<sup>135</sup> Linking Field's and Megginson/Weiss' argument, one may conclude that VC backed IPOs with high reputation underwriters have higher institutional ownership and are likely to perform better than other IPOs. However, altogether underwriter reputation does not seem to alter post-IPO returns on an overly significant basis, the results are consistent with prior US-evidence.<sup>136</sup>

### 4.3 The Expiration of Lock-Up Agreements as a Proxy for the Exit of Venture Capitalists

#### 4.3.1 Abnormal Returns around the Event Day

The analysis in section 4.2 showed that VC backed firms started to underperform the NASDAQ Composite from the 25<sup>th</sup> trading week onwards while non-VC backed IPOs appeared to underperform after week 50 (Figure 2). Since the majority of lock-ups of the VC sample terminated after 6 months (i.e. in trading week 25<sup>137</sup>) and that of the NVC sample after 12 months (i.e. in trading week 51), expiring lock-ups and the subsequent exit of VCs may contribute to explanations for underperformance. Hence, the expiration of lock-ups is used as a proxy for the unknown exit time. This section will test the short-run implications of this while section 4.4 focuses on the longer performance implications of expiring lock-up periods.

Total sample results with *CARs* of -1.52% for compulsory lock-ups and -1.05% for all lock-ups over the time window [-2; +2]<sup>138</sup> confirm the prior *Neuer Markt* evidence of Nowak/Gropp (2002), who also found significant negative abnormal returns of IPOs around

<sup>131</sup> See Table 6, Panel A1 and B1.

<sup>132</sup> Due to the spillover effects between NEMAX and IPOs on *Neuer Markt* the following explanations refer to the NASDAQ results only.

<sup>133</sup> See Field (1995), Table 4 and pp. 12-14.

<sup>134</sup> See Megginson/Weiss (1991), p. 892.

<sup>135</sup> See Brav/Gompers (1997), p. 1819.

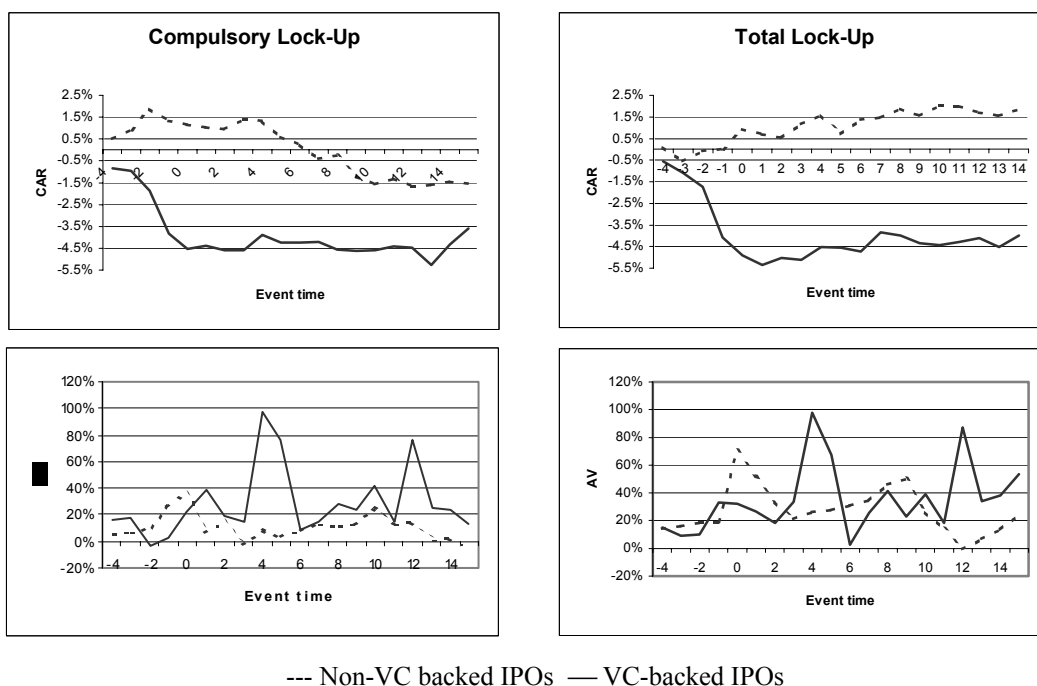
<sup>136</sup> See Doukas/Gonenc (2000), pp. 17-19.

<sup>137</sup> Keep in mind, that according to the weekly schedule here, the first week after the IPO is not taken into account for reasons explained in Section 3.

<sup>138</sup> See Table 14 in the appendix.

the expiration date of the lock-up period.<sup>139</sup> Price decreases and consequently *CARs* around the expiration of lock-up agreements, however, are stronger for VC backed firms. This holds regardless of whether the analysis is performed for compulsory or total lock-up agreements that include commitments towards lead underwriters. In the first case, VC backed IPOs yielded a negative abnormal return of 3.6 percent, in the second case of 3.9 percent from event day -2 to +2, with the heaviest price shock occurring on event date -1. Around 60 percent of VC backed firms had negative returns upon the expiration of lock-up agreements. However, non-VC backed IPOs did not perform significantly abnormal. Hence, the expiration of lock-up periods seems to be relevant for VC backed companies only.

Figure 3: VC and NVC CARs and AVs [-4;+15] for compulsory and total Lock-Up Agreements



--- Non-VC backed IPOs — VC-backed IPOs

Table 7: VC and NVC CARs and AVs [-4;+15] for compulsory and total Lock-Up Agreements

	CAR	Median	1st Q	3rd Q	N/N	average AV
<b>Panel A: Compulsory Lock-Up only</b>						
<b>Full Sample</b>	-2.411% (-1.857) <sup>c</sup>	-2.231%	-17.307%	13.902%	54%	
<b>VC</b>	-3.597% (-1.656) <sup>c</sup>	-2.231%	-18.039%	10.947%	53%	27%
<b>NVC</b>	-1.552% (0.684)	-2.023%	-14.572%	14.715%	54%	10%
<b>Difference in CAR<sup>1</sup></b>	(0.615)	[0.684]				
<b>Panel B: Full Lock-Up</b>						
<b>Full Sample</b>	-0.249% (-0.172)	-1.316%	-15.688%	13.509%	53%	
<b>VC</b>	-2.891% (-1.238)	-4.100%	-18.162%	10.405%	53%	35%
<b>NVC</b>	1.741% (0.988)	-0.108%	-11.252%	14.177%	51%	27%
<b>Difference in CAR<sup>1</sup></b>	(1.596) <sup>d</sup>	[1.610] <sup>d</sup>				

t-Statistics in parenthesis

<sup>1</sup> t-Statistics for difference-in-means in parenthesis; Mann/Whitney-Test for difference-in-medians in brackets

<sup>a</sup> Significant on a 1%-Level

<sup>b</sup> Significant on a 5%-Level

<sup>c</sup> Significant on a 10%-Level

<sup>d</sup> Significant on a 15%-Level

Figure 3 and Table 7 show *CARs* and *AVs* for a wider event window ranging from event day -4 to 15 trading days after the IPO. VC backed IPOs performed worse than non-VC backed IPOs on the basis of means, medians and quartiles<sup>140</sup>.

*CARs* did not exhibit a tendency to revert to the old price level prior to the event, which provides a first support for hypothesis H4b of downward sloping demand curves. These results are consistent with the US evidence. As outlined further above, Bradley et al. (2000), Brav/Gompers (2000) and Field/Hanka (2001) all found VC backed IPOs to be more prone to negative abnormal returns upon the expiration of lock-up periods.<sup>141</sup> Consistent with hypothesis H5, both samples exhibit higher than average abnormal trading volumes over the event window. However, in line with hypothesis H6, the average *AV* is higher for VC backed stocks than for non-VC backed stocks. This may be taken as evidence in favor of the presumed exit of VCs soon after the expiration of lock-up agreements.

### 4.3.2 Robustness tests

One concern about the robustness of the results is that the strength of the price decrease around the event may be related to the length of the lock-up period. Field/Hanka (2001) report stronger price decreases for firms with lock-ups smaller than 180 days relative to firms with lock-ups of longer than 180 days.<sup>142</sup> To disentangle the effects of VC backing and lock-up length, IPOs are categorized by the length of their lock-up period. Table 8 reports the results.

*Table 8: Abnormal Returns in dependence of Length of total Lock-Up Agreements*

The sample is 293 IPOs classified by the length of their total lock-up agreement (including commitments to underwriters). For sample sizes see Table 3.

	<12	12	>12	Test <sup>1</sup>	<12	12	>12	Test <sup>1</sup>
	Panel A: CAR [-4;+15]				Panel B: CAR [-2;+2]			
<b>VC</b>	-0.033	0.003	-0.156	0.857	-0.051	-0.007	-0.044	0.913
	<i>-0.020</i>	<i>-0.045</i>	<i>-0.173</i>	<i>1.999</i>	<i>-0.035</i>	<i>-0.015</i>	<i>-0.036</i>	<i>1.569</i>
<b>NVC</b>	0.012	0.011	0.134	1.088	0.011	0.008	0.064	0.564
	<i>0.025</i>	<i>-0.022</i>	<i>0.112</i>	<i>2.282</i>	<i>-0.010</i>	<i>-0.003</i>	<i>0.098</i>	<i>1.166</i>
<b>Test<sup>2</sup></b>	1.072	0.161	2.759 <sup>a</sup>		2.357 <sup>a</sup>	0.560	1.441	
	<i>1.201</i>	<i>0.208</i>	<i>2.415<sup>b</sup></i>		<i>1.667<sup>c</sup></i>	<i>0.483</i>	<i>1.098</i>	
<b>Total</b>	-0.014	0.009	0.023	0.343	-0.024	0.004	0.022	1.478
	<i>0.002</i>	<i>-0.026</i>	<i>-0.048</i>	<i>0.537</i>	<i>-0.020</i>	<i>-0.014</i>	<i>0.018</i>	<i>2.507</i>

First row gives means, median in second row in italics

<sup>1</sup> upper figure gives ANOVA F-Test of difference-in-means, lower figure Van-der-Waerden Z-Score for difference-in-Medians

<sup>2</sup> upper row gives normal T-Test statistics; lower row gives results of Mann-Whitney U-Test for difference-in-medians.

<sup>a</sup> significant on a 1%-level

<sup>b</sup> significant on a 5%-level

<sup>c</sup> significant on a 10%-level

If negative *CARs* are driven by the length of lock-up agreements rather than by VC backing, one would expect significant differences on the time scale and insignificance on the VC-NVC axis. However, the length of the lock-up period does not drive *CARs*.<sup>143</sup> While the VC sub sample always has lower means and medians the time pattern does not seem to be clear cut.

<sup>140</sup> The reported quartile mean returns with lower 1<sup>st</sup> Q and 3<sup>rd</sup> Q means indicate that the differences in overall means and median are not caused by outliers but by an overall different distribution.

<sup>141</sup> See Field/Hanka (2001), Bradley et al. (2000) and Brav/Gompers (2000)

<sup>142</sup> See Field/Hanka (2001), Table 3 and p. 484.

<sup>143</sup> This is consistent with e.g. Ofek/Richardson's (2000) and Brav/Gompers' (2001) OLS regression where the length of the lock-up period has no power in explaining cumulative abnormal returns.

Furthermore, tax considerations might influence underperformance. Under German law, German retail investors had to pay a speculation tax (*Spekulationssteuer*)<sup>144</sup> if they bought and sold investments within a certain period of time only, whereas otherwise gains were tax-exempt. Therefore, abnormal returns and abnormal volume around the event could in fact be caused by retail investors' disinvestments at the end of the respective minimum holding period after the IPO. With effect from 1<sup>st</sup> January 1999, the length of this period was adjusted from 6 to 12 months. Thus, *CARs* of IPOs with 6 month lock-ups should be lower before the change. Similarly, *CARs* of firms with 12 month lock-ups should decline after the change. These effects are examined by classifying IPOs according to their IPO date and subsequently grouping them to VC and NVC sub-samples.<sup>145</sup> We observe that the tax considerations explained above are not a driver for negative *CARs*, since the earlier predictions do not hold.

### 4.3.3 Multivariate Analysis of Abnormal Returns

To identify the determining factors of abnormal returns around the expiration of lock-up agreements, we use a multivariate OLS regression analysis. If the exit of VCs is the main driver behind the stronger price decrease for VC backed firms, differences in the significance of the various regressors between the two samples can be expected. Since VC backing over and above the pure level effect may also have a slope effect, each regression was performed twice, once with and once without an interactive dummy.<sup>146</sup> The interactive dummy, i.e. the product of the original regressor and a binary variable, indicating VC backing with '1', picks up slope effects for VC backed firms.<sup>147</sup> The dependent variable is the *CAR* over the window [-4;15]. Independent variables are the VC dummy (*VC*), the residual standard deviation over the estimation window (*ResidSD*), a company's initial free float (*FF*), a performance measure for the first 24 trading weeks and the Euromoney reputation measure binary variable (*EM*) as explained above. Table 9 presents the results. *ResidSD* is expected to be negatively related to *CARs*.<sup>148</sup> The higher a stock's residual standard deviation, the higher is its unsystematic risk and the more investors will seek diversification and thus dispose their holdings after shares become freely tradable. Since this holds for all pre-IPO-shareholders and not only for VCs, *ResidSD* is not controlled for interactively.<sup>149</sup> Secondly, companies with lower free floats see more shares locked in. The lower the *FF* and thus the higher the percentage of locked shares, the more negative we expect the impact of *FF* on abnormal returns to be.

If VCs, in contrast to other existing shareholders, sell their shares quickly after the expiration of lock-up agreements, *FF* is expected to have a higher negative effect on the VC than on the NVC sample. Following the *disposition effect*<sup>150</sup> VCs should be more prone to sell past out-

<sup>144</sup> See §§ 22,23 ESTG.

<sup>145</sup> See Table 15 in the appendix.

<sup>146</sup> See Maddala (1992), pp. 306-315, on dummy variables for intercept and slope changes.

<sup>147</sup> Alternatively, the regressions could have been run separately for each sample instead of the total sample. However, this approach does not allow to have common, non-interactive variables such as *ResidSD* in Table 10 and would lower degrees of freedom. However, in theory, a coefficient of a sub-sample (here VC backing) regression should equal the sum of the coefficient on the full regressor and the coefficient of the interactive regressor. This interactive dummy variable approach helps also to avoid the pooling problem identified by Bradley et al. (2000), p. 22, 23.

<sup>148</sup> See Ofek/Richardson (2000), p. 223, use of total *sd* as an regressor.

<sup>149</sup> However, one could argue that shareholders other than VCs are more likely to sell shares in order to optimize their risk-return trade-off, since by definition a VC is a specialist asset manager with the clear intention to speculate on idiosyncratic risks, namely the performance of technology-oriented ventures.

<sup>150</sup> The disposition effect as e.g. in Shefrin/Statman (1985) essentially states that investors are more eager to realise gains than their losses.

performers than past losers. Consequently, 24 weeks post-IPO performance<sup>151</sup> is used as an additional regressor and is expected to be negatively related to the abnormal returns around the expiration of lock-up periods.<sup>152</sup>

Table 9: OLS Regression Results for CARs in total Event Window

Dependent variable is the cumulative abnormal return (CAR) over the event window [-4;15] around the expiration of the compulsory lock-up agreement. Each regression was carried out twice, once without an interactive VC dummy and once with an interactive VC dummy, that picks up slope effects (labelled EQ1 int.).

	EQ 1	EQ 1 int.	EQ 2	EQ 2 int.	EQ 3	EQ 3 int.	EQ 4	EQ 4 int.
<b>Panel A: Compulsory Lock-Up period</b>								
<b>Intercept</b>	-0.135 <sup>a</sup> (-2.778)	-0.056 (-0.919)	-0.129 <sup>a</sup> (-2.477)	-0.052 (-0.843)	-0.137 <sup>a</sup> (-2.699)	-0.059 (-0.972)	-0.158 <sup>a</sup> (-3.013)	-0.088 (-1.374)
<b>ResidSD</b>	1.980 <sup>b</sup> (2.122)	1.906 <sup>a</sup> (2.360)	1.411 (1.632)	1.553 <sup>c</sup> (1.877)	1.977 <sup>a</sup> (2.356)	1.940 <sup>a</sup> (2.386)	2.156 <sup>a</sup> (2.574)	2.095 <sup>a</sup> (2.579)
<b>VC</b>	-0.031 (-0.983)	-0.132 <sup>b</sup> (-2.047)	-0.032 (-1.025)	-0.128 <sup>b</sup> (-1.997)	-0.031 (-1.022)	-0.132 <sup>b</sup> (-2.071)	-0.029 (-0.930)	-0.111 <sup>c</sup> (-1.649)
<b>FF</b>	0.122 (1.246)	-0.135 (-0.981)	0.167 (1.553)	-0.111 (-0.781)	0.126 (1.220)	-0.133 (-0.972)	0.128 (1.257)	-0.136 (-0.971)
<b>FF*VC</b>		0.360 <sup>b</sup> (2.195)		0.364 <sup>b</sup> (2.160)		0.359 <sup>b</sup> (2.185)		0.357 <sup>b</sup> (2.144)
<b>RawRet<sub>24</sub></b>	-0.026 <sup>a</sup> (-2.706)	-0.014 (-1.231)						
<b>RawRet<sub>24</sub>*VC</b>		-0.035 <sup>c</sup> (-1.865)						
<b>BAR<sub>i,24</sub>(NEMAX)</b>			-0.006 (-1.128)	0.000 (0.043)				
<b>BAR<sub>i,24</sub>(NEMAX)*VC</b>				-0.062 <sup>a</sup> (-3.255)				
<b>BAR<sub>i,24</sub>(NASDAQ)</b>					-0.027 <sup>b</sup> (-2.055)	-0.013 (-1.242)	-0.028 <sup>b</sup> (-2.058)	-0.014 (-1.262)
<b>NASDAQ<sub>i,24</sub>(NASDAQ)*VC</b>						-0.045 <sup>b</sup> (-2.266)		-0.046 <sup>b</sup> (-2.317)
<b>EM</b>							0.037 (1.136)	0.077 <sup>c</sup> (1.813)
<b>EM*VC</b>								-0.067 (-1.053)
<b>Adjusted R<sup>2</sup></b>	0.034	0.051	0.013	0.045	0.033	0.053	0.035	0.057
<b>F-Test</b>	3.683	3.704	2.015	3.361	3.572	3.814	3.157	3.259

t-values in parenthesis

(see panel B for a similar regression with CARs for total lock-ups in the appendix)

<sup>a</sup> significant on a 1%-level

<sup>b</sup> significant on a 5%-level

<sup>c</sup> significant on a 10%-level

The results indicate differences in the determination of *CARs* between VC and non-VC backed firms and are supportive for the exit hypothesis. Residual standard deviation (*ResidSD*) of the estimation window has significant explanatory power; *VC* and *FF* both do not have a significant impact in the simple regressions (EQ1-EQ4). However, they are significant for VC backed firms on conventional significance levels after controlling interactively for VC backing (EQ1 int.-EQ4 int.). Thus, *CARs* of VC backed firms increase in *FF* and decrease in pre-exit performance. *CARs* of non-VC backed firms are not explained by *FF* and pre-exit performance. Underwriter reputation does not explain the cross section of returns.

<sup>151</sup> For simplicity, we did not calculate a backward looking performance measure of i.e. 6 months pre-exit performance but used the 24 weeks aftermarket performance of Section 4.2.

<sup>152</sup> Gompers/Lerner (1998), Table 3 with “net-of-market returns before distribution” and Field/Hanka (2001), Table 4 with “price run-up” employ a similar variable.

Over and above, VC backing has a significant negative effect on *CARs* around the expiration of lock-up periods. The results supports the hypothesis that VCs quickly sell their holdings in VC backed firms after the expiration of lock-up agreements, and that the impact on *CARs* is more severe the more shares are locked in and the better a stock performed prior to the expiration. Thus, VCs' selling decisions appear to be the main driver behind negative *CARs* of VC backed firms immediately after the expiration of the lock-up period.

#### 4.4 The Expiration of Lock-Up Agreements as a Breakpoint in Post-IPO Performance

Section 4.3 provided arguments for the short-run importance of a VC's exit decision. In this section we will examine whether exits have an impact on performance in the longer run. The key question is whether returns before the expiration of lock-up periods differ significantly from returns thereafter. Firstly, this is tested with the simple dummy variable approach.

The results in Table 10 support the downward sloping demand curves hypothesis (H4b) since prices do not appear to bounce back to pre-expiration levels. However, VC-backed IPOs are not more prone to this return decrease than other IPOs as shown by the insignificant differences between the coefficient estimates. Hence, the results of the dummy test only partly support the line of argumentation in Chapter 2. Secondly, Chow breakpoint tests as described in section 3.4 together with the according dummy variable approach were conducted. Both, the regressor *Dummy* and the test-statistic of the Chow Breakpoint Test reported in Table 11 indicate whether the expiration of lock-up agreements is a breakpoint in the regression of the time series of weekly stock returns on market index returns. In part 1, dummy as well as breakpoint tests signal significance only for lock-up periods of 6 months. One may interpret this either as a *non-rejection* of the null hypothesis that breakpoints do not exist or argue that market participants focus on compulsory and thus more reliable lock-up agreement.

Table 10: Estimates for OLS Regression Breakpoint Dummy Coefficient

The Sample is a total of 287 IPOs with lock-up agreements of less than 18 months. Mean and Medians refer to estimates of the coefficient  $\gamma$  from the OLS regression:  $AR_i = \alpha_p + \gamma_i D_i$  where  $AR_i$  is a vector of weekly abnormal returns of the 74 weeks following the IPO and  $BV_i$  is a binary variable that takes the value 1 as long as the lock-up period has not expired and zero thereafter. The  $AR_i$ s are equally weighted returns based on portfolios of 4-5 stocks with lock-periods of the same length.

	Panel A: NASDAQ AR, 74 weeks		Panel B: NEMAX AR, 74 weeks	
	Mean	Median	Mean	Median
<b>VC</b>	0.013 <sup>a</sup> (2.735)	0.008 <sup>a</sup> (2.760)	0.009 <sup>b</sup> (2.180)	0.008 <sup>b</sup> (2.013)
<b>NVC</b>	0.010 <sup>a</sup> (3.009)	0.013 <sup>a</sup> (2.793)	0.006 <sup>b</sup> (2.109)	0.004 <sup>b</sup> (2.009)
<b>Difference Test</b>	0.462 <sup>1</sup>	0.099 <sup>2</sup>	0.708 <sup>1</sup>	0.442 <sup>2</sup>

t-statistics in parenthesis, Wilcoxon Z-Score in parenthesis and italics

<sup>1</sup> T-Test for Difference-in-means

<sup>2</sup> Mann-Whitney Z-Score for difference-in-medians

<sup>a</sup> significant on a 1%-Level

<sup>b</sup> significant on a 5%-Level

<sup>c</sup> significant on a 10%-Level

Hence, similar regressions for compulsory lock-ups are reported in part 2 of Table 11. The findings broadly confirm the earlier supposition of section 2. The end of lock-up agreements represents a significant breakpoint under both tests, dummy and Chow Breakpoint Test, for the VC sample. VC backed firms perform significantly better before the expiration of lock-up

periods; thereafter, ARs decline by, on average, 1.4%. Results are not so clearly cut for the NVC sample where the Chow test is insignificant. Hence, the results reported in Table 11, part 2 confirm the interaction of hypotheses H2 and H3 and signal that the presumed exit of VCs after the expiration of lock-up periods has a significant negative impact on post-IPO performance. Furthermore, the results may also be interpreted as evidence in favor of downward sloping demand curves, thus supporting hypothesis H4b.<sup>153</sup>

*Table 11: Expiry Dates of Lock-Up Agreements as possible Breakpoints*

The sample is 74 trading weeks raw returns and corresponding NASDAQ Composite returns for a total sample of overall 287 IPOs with expiring lock-up periods within 18 months. Raw returns and corresponding index returns are grouped to equally weighted portfolios of stocks with lock-up periods of similar lengths.

	Part 1: Soft lock up			Part 2: Hard lock up	
Panel A: VC backed					
	6 Months	9 Months	12 Months	6 Months	9 Months
<b>N</b>	75	4	26	115	2
<b>Intercept</b>	-0.008 <sup>a</sup>	-0.008	-0.008	-0.008 <sup>a</sup>	-0.005
	(-3.262)	(-0.972)	(-1.791)	(-3.722)	(-0.538)
<b>R<sub>NASDAQ,74</sub></b>	1.211 <sup>a</sup>	0.422	0.623	0.996 <sup>a</sup>	0.493 <sup>b</sup>
	(6.977)	(2.390)	(2.081)	(4.967)	(2.496)
<b>Dummy</b>	0.015 <sup>a</sup>	0.009	0.001	0.014 <sup>a</sup>	0.011
	(3.053)	(0.710)	(0.087)	(3.250)	(0.818)
<b>Adjusted R<sup>2</sup></b>	0.435	0.049	0.028	0.360	0.059
<b>F-Test</b>	29.059 <sup>a</sup>	2.886 <sup>c</sup>	2.060	21.530 <sup>a</sup>	3.295 <sup>b</sup>
<b>Chow Breakpoint Test<sup>1</sup></b>	8.668 <sup>a</sup>	1.065	1.320	10.222	1.593
<b>White Heteroscedasticity<sup>2</sup></b>	2.033	0.922	0.780	0.721	3.695 <sup>b</sup>
	4.008	1.873	1.591	1.473	6.976 <sup>b</sup>
Panel B: non-VC backed					
	6 Months	12 Months	6 Months	12 Months	
<b>N</b>	62	76	146	36	
<b>Intercept</b>	-0.006 <sup>b</sup>	-0.008 <sup>c</sup>	-0.004	-0.008	
	(-2.151)	(-1.791)	(-1.414)	(-1.287)	
<b>R<sub>NASDAQ,74</sub></b>	0.948 <sup>a</sup>	0.623 <sup>b</sup>	0.902 <sup>a</sup>	0.913	
	(3.626)	(2.081)	(4.218)	(3.726)	
<b>Dummy</b>	0.013 <sup>a</sup>	0.001	0.008 <sup>b</sup>	0.011	
	(2.767)	(0.087)	(2.024)	(1.278)	
<b>Adjusted R<sup>2</sup></b>	0.293	0.028	0.364	0.133	
<b>F-Test</b>	16.131 <sup>a</sup>	2.060	21.878 <sup>a</sup>	6.617 <sup>a</sup>	
<b>Chow Breakpoint Test<sup>1</sup></b>	3.605 <sup>b</sup>	1.320	1.534	0.892	
<b>White Heteroscedasticity<sup>2</sup></b>	0.011	0.780	0.731	0.891	
	0.023	1.591	1.493	1.811	

t-statistics in parenthesis

1 F-Statistics of Chow Breakpoint-Test for breakpoint after 25, 36, 51 weeks

2 F-Statistics of White Heteroscedasticity Test

<sup>a</sup> significant on a 1%-level

<sup>b</sup> significant on a 5%-level

<sup>c</sup> significant on a 10%-level

<sup>153</sup> Note, that if H4a were true, one would not expect the expiration of lock-up periods to be a significant breakpoint for weekly returns, since stock prices should revert to their old level after a short time. Hence, a significant dummy signals a more permanent price decline, thus providing support for H4b.

## 5. Conclusions

We examine the impact of Venture Capitalists (VC) on the long-run performance of IPOs on Germany's *Neuer Markt*. Tighter monitoring and a reduced heterogeneity of opinions might explain a superior post-IPO performance of VC backed firms. However, any VC backed IPO will turn into a non-VC backed firm, since VCs will reallocate services and time committed to the venture and exit from their investment. Therefore, a VC's exit may represent a breakpoint in a VC backed firm's return series, which does not have an equivalent in the return series of non-VC backed firms. Because the actual exit decision is unobservable, we assume – in line with prior evidence – that the exit occurs soon after the end of the lock-up period and thus we use the expiration date as a proxy for the exit date. We use a of 312 IPOs on Germany's *Neuer Markt* over the period 1997-2001. In the shorter run of 6 months, VC backed firms outperformed the NASDAQ Composite and NEMAX All Share Indices as benchmarks as well as the non-VC backed IPO control sample while both samples yielded similar negative returns on an absolute and relative basis over longer periods of 18 months.

Although the expiration date is publicly available information, VC backed stocks suffer from a stronger price decrease around the expiration of lock-up agreements that is accompanied by higher abnormal trading volumes relative to non-VC backed stocks. Consistent with the assumption of downward sloping demand curves, share prices do exhibit only a weak tendency to bounce back to their old pre-expiration levels. Negative abnormal returns of VC backed firms are driven by prior performance and lower initial free float levels (i.e., a higher fraction of locked shares) which both in conjunction with inconsistency of these variables for the non-VC backed sample provide support for the exit hypothesis.

In the longer run, the hypothesis that the expiration of lock-up periods and the presumed exit of Venture Capitalists represent a breakpoint as described above is only partly supported by conducted tests. While it appears that the expiration date is definitely a breakpoint for VC backed stocks, it may play a similar role in the returns series of non-VC backed stocks.

As such, the findings in this paper document persistent market inefficiency in the incorporation of publicly available information into stocks prices. Furthermore, they confirm the impact of block holder sales, here Venture Capitalists, on stocks returns.

The results may bear some suggestions for the Venture Capital Industry. Firstly, when Venture Capitalists exit from their investments, they should try to avoid direct sales over the stock exchange, since presumably these sales have the strongest negative price impact. Furthermore, since the longer run underperformance (after the exit) may be related to the termination of a Venture Capitalist's exercised corporate control, the underperformance problem may be overcome if a Venture Capitalist sells her block holdings to other institutions that are also specialized on playing an important monitoring role. Such post-Venture managers may fill the vacuum in the governance of young firms that stems from the exit of Venture Capitalist.

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## Appendix

Table 12: Abnormal Returns of VC and NVC Sample against NASDAQ Composite over 74 Trading Weeks

The sample is the number of VC or non-VC backed IPOs with the number of N IPOs as stated in table 5, 1<sup>st</sup> column.  $AR_t$  is the abnormal return of an equally weighted portfolio of IPOs in week  $t$  after the IPO.  $N^-/N$  gives the ratio of negative observations in week  $t$  within the portfolio relative to all observations.  $CAR_T$  gives the cumulative abnormal return of this portfolio achieved over the  $t$  weeks following the IPO.

Week	Panel A: VC backed NASDAQ						Panel B: NVC backed NASDAQ					
	$AR_t$	t-Stat	Sign Test	$N^-/N$	$CAR_T$	t-Stat	$AR_t$	t-Stat	Sign Test	$N^-/N$	$CAR_T$	t-Stat
1	0.0112	0.975	-0.260	51.1%	0.0112		0.0241	1.659	-1.121	54.2%	0.0241	
2	0.0061	0.522	-1.301	55.6%	0.0173	1.012	0.0055	0.536	-0.374	51.4%	0.0297	2.179 <sup>b</sup>
3	0.0117	1.171	-0.260	51.1%	0.0290	1.383	0.0073	0.811	-0.224	50.8%	0.0370	2.220 <sup>b</sup>
4	-0.0079	-0.818	-0.434	51.9%	0.0211	0.875	-0.0108	-1.302	-3.214 <sup>a</sup>	62.0%	0.0262	1.365
5	0.0210	1.920 <sup>c</sup>	0.780	46.6%	0.0421	1.567	-0.0091	-0.976	-3.662 <sup>a</sup>	63.7%	0.0170	0.786
6	0.0027	0.219	-1.994 <sup>b</sup>	58.6%	0.0447	1.511	-0.0114	-1.425	-2.168 <sup>b</sup>	58.1%	0.0056	0.236
7	0.0064	0.560	-0.954	54.1%	0.0512	1.597	0.0051	0.543	-1.570	55.9%	0.0107	0.423
8	-0.0017	-0.157	-0.780	53.4%	0.0494	1.444	-0.0026	-0.280	-1.719 <sup>c</sup>	56.4%	0.0081	0.299
9	0.0333	2.510 <sup>a</sup>	1.301	44.4%	0.0828	2.299 <sup>b</sup>	0.0173	1.756	0.374	48.6%	0.0254	0.884
10	-0.0017	-0.124	-0.954	54.1%	0.0811	2.135 <sup>b</sup>	0.0081	0.940	-0.523	52.0%	0.0335	1.096
11	-0.0018	-0.165	-1.127	54.9%	0.0793	1.970 <sup>c</sup>	0.0073	0.792	-0.972	53.6%	0.0407	1.276
12	0.0164	1.117	-1.821 <sup>c</sup>	57.9%	0.0957	2.289 <sup>b</sup>	0.0021	0.206	-2.467 <sup>a</sup>	59.2%	0.0428	1.286
13	0.0009	0.090	-0.087	50.4%	0.0966	2.218 <sup>b</sup>	-0.0121	-1.176	-3.214 <sup>a</sup>	62.0%	0.0307	0.888
14	0.0222	1.656	0.780	46.6%	0.1188	2.632 <sup>a</sup>	0.0041	0.483	-0.224	50.8%	0.0349	0.972
15	0.0087	0.683	-0.954	54.1%	0.1276	2.711 <sup>a</sup>	-0.0065	-0.739	-2.766 <sup>a</sup>	60.3%	0.0284	0.764
16	0.0177	1.657	-0.434	51.9%	0.1452	2.991 <sup>a</sup>	-0.0063	-0.743	-1.121	54.2%	0.0221	0.572
17	-0.0004	-0.036	-0.780	53.4%	0.1448	2.910 <sup>a</sup>	0.0215	2.061	-0.673	52.5%	0.0435	1.109
18	0.0047	0.396	-0.434	51.9%	0.1495	2.910 <sup>a</sup>	-0.0124	-1.545	-2.915 <sup>a</sup>	60.9%	0.0312	0.777
19	0.0026	0.199	-1.648	57.1%	0.1521	2.881 <sup>a</sup>	0.0020	0.200	-1.420	55.3%	0.0332	0.792
20	0.0050	0.435	-1.127	54.9%	0.1570	2.900 <sup>a</sup>	0.0011	0.117	-1.869 <sup>c</sup>	57.0%	0.0342	0.797
21	-0.0080	-0.499	-2.515 <sup>a</sup>	60.9%	0.1490	2.685 <sup>a</sup>	0.0089	0.844	-1.420	55.3%	0.0431	0.980
22	-0.0127	-0.959	-3.035 <sup>a</sup>	63.2%	0.1363	2.373 <sup>a</sup>	0.0017	0.204	-1.420	55.3%	0.0449	0.995
23	-0.0114	-0.900	-2.515 <sup>a</sup>	60.9%	0.1249	2.120 <sup>b</sup>	-0.0175	-1.958 <sup>c</sup>	-2.766 <sup>a</sup>	60.3%	0.0273	0.593
24	-0.0069	-0.550	-1.821 <sup>c</sup>	57.9%	0.1180	1.971 <sup>b</sup>	0.0157	1.209	-0.075	50.3%	0.0430	0.929
25	-0.0458	-3.796 <sup>a</sup>	-4.490 <sup>a</sup>	69.8%	0.0902	1.458	0.0104	0.900	-1.578	55.9%	0.0517	1.062
26	-0.0020	-0.150	-0.792	53.5%	0.0882	1.412	-0.0088	-1.010	-2.330 <sup>a</sup>	58.8%	0.0429	0.875
27	0.0119	0.943	-2.025	58.9%	0.1001	1.581	-0.0193	-2.055 <sup>b</sup>	-2.781 <sup>a</sup>	60.5%	0.0236	0.464
28	0.0167	1.466	-0.088	50.4%	0.1168	1.790 <sup>b</sup>	-0.0116	-1.407	-1.879 <sup>c</sup>	57.1%	0.0120	0.231
29	0.0026	0.256	-0.264	51.2%	0.1194	1.812 <sup>b</sup>	-0.0061	-0.670	-2.330 <sup>a</sup>	58.8%	0.0059	0.113
30	0.0096	0.871	-0.264	51.2%	0.1290	1.927 <sup>b</sup>	0.0099	1.005	0.376	48.6%	0.0158	0.300
31	-0.0144	-1.540	-2.025 <sup>b</sup>	58.9%	0.1146	1.699 <sup>b</sup>	-0.0066	-0.684	-1.729 <sup>c</sup>	56.5%	0.0093	0.173
32	-0.0112	-1.071	-2.553 <sup>a</sup>	61.2%	0.1034	1.487	-0.0096	-0.936	-2.631 <sup>a</sup>	59.9%	-0.0004	-0.006
33	-0.0131	-1.175	-2.025 <sup>b</sup>	58.9%	0.0903	1.279	-0.0118	-1.027	-2.631 <sup>a</sup>	59.9%	-0.0121	-0.216
34	0.0032	0.273	-0.440	51.9%	0.0935	1.317	0.0238	1.663	-1.127	54.2%	0.0116	0.210
35	-0.0144	-1.009	-3.258 <sup>a</sup>	64.3%	0.0791	1.098	0.0229	2.185	-0.376	51.4%	0.0345	0.588
36	-0.0170	-1.194	-1.849 <sup>c</sup>	58.1%	0.0621	0.838	0.0083	0.987	-0.075	50.3%	0.0429	0.733
37	-0.0130	-1.186	-2.377 <sup>a</sup>	60.5%	0.0491	0.654	-0.0214	-2.410	-2.931 <sup>a</sup>	61.0%	0.0215	0.369
38	0.0003	0.024	-3.082 <sup>a</sup>	63.6%	0.0494	0.657	-0.0023	-0.195	-1.879 <sup>c</sup>	57.1%	0.0192	0.320
39	-0.0046	-0.394	-1.497	56.6%	0.0448	0.587	-0.0068	-0.692	-1.879 <sup>c</sup>	57.1%	0.0124	0.205
40	-0.0138	-1.007	-2.377 <sup>a</sup>	60.5%	0.0310	0.400	-0.0005	-0.050	-0.225	50.8%	0.0120	0.195
41	0.0063	0.561	-0.792	53.5%	0.0373	0.479	-0.0091	-0.994	-1.428	55.4%	0.0029	0.047
42	0.0231	1.902 <sup>b</sup>	-0.088	50.4%	0.0603	0.757	0.0130	1.085	-0.977	53.7%	0.0159	0.255
43	-0.0108	-0.887	-1.321	55.8%	0.0495	0.627	0.0076	0.823	-0.676	52.5%	0.0234	0.368
44	-0.0119	-1.042	-2.377 <sup>a</sup>	60.5%	0.0377	0.462	-0.0090	-0.999	-3.382 <sup>a</sup>	62.7%	0.0144	0.225
45	0.0061	0.446	-1.497	56.6%	0.0438	0.537	-0.0135	-1.412	-1.578	55.9%	0.0009	0.014

( continued on the following page)

Table 12 (Cont'd): Abnormal Returns of VC and NVC Sample against NASDAQ Composite over 74 Trading Weeks

Panel A: VC backed NASDAQ (cont'd)							Panel B: NVC backed NASDAQ (cont'd)					
Week	AR	t-Stat	Sign Test	N/N	CAR <sub>T</sub>	t-Stat	AR	t-Stat	Sign Test	N/N	CAR <sub>T</sub>	t-Stat
46	-0.0274	-2.674	-2.201 <sup>b</sup>	59.7%	0.0163	0.199	-0.0015	-0.155	-1.127	54.2%	-0.0006	-0.009
47	-0.0032	-0.311	-1.497	56.6%	0.0131	0.156	0.0109	0.888	-1.578	55.9%	0.0104	0.156
48	0.0011	0.091	-0.616	52.7%	0.0142	0.169	-0.0207	-2.760	-2.480 <sup>a</sup>	59.3%	-0.0103	-0.156
49	0.0013	0.088	-1.849 <sup>c</sup>	58.1%	0.0156	0.182	-0.0101	-1.094	-0.827	53.1%	-0.0204	-0.297
50	-0.0254	-1.929	-2.729 <sup>b</sup>	62.0%	-0.0098	-0.114	-0.0252	-2.246	-2.931 <sup>a</sup>	61.0%	-0.0456	-0.654
51	-0.0323	-2.978	-2.842 <sup>b</sup>	63.0%	0.0011	0.011	-0.0169	-1.654	-2.617 <sup>a</sup>	60.4%	-0.0309	-0.409
52	-0.0409	-3.760	-4.308 <sup>a</sup>	69.7%	-0.0399	-0.416	-0.0288	-2.918	-2.776 <sup>a</sup>	61.0%	-0.0597	-0.782
53	0.0022	0.230	0.642	47.1%	-0.0377	-0.415	0.0086	0.846	-0.714	52.8%	-0.0512	-0.693
54	0.0005	0.043	-0.458	52.1%	-0.0372	-0.401	-0.0099	-0.986	-0.555	52.2%	-0.0611	-0.814
55	-0.0149	-1.372	-2.292 <sup>b</sup>	60.5%	-0.0521	-0.558	-0.0180	-1.697	-2.141 <sup>b</sup>	58.5%	-0.0791	-1.025
56	-0.0196	-1.839	-2.475 <sup>a</sup>	61.3%	-0.0717	-0.753	-0.0082	-0.872	-1.031	54.1%	-0.0873	-1.124
57	-0.0135	-1.163	-1.558	57.1%	-0.0851	-0.887	-0.0351	-3.555	-3.093 <sup>a</sup>	62.3%	-0.1224	-1.547
58	-0.0120	-0.867	-2.108 <sup>b</sup>	59.7%	-0.0971	-1.007	-0.0200	-1.992	-3.252 <sup>a</sup>	62.9%	-0.1424	-1.743 <sup>c</sup>
59	0.0253	1.758	0.458	47.9%	-0.0718	-0.751	-0.0026	-0.278	-1.983 <sup>b</sup>	57.9%	-0.1451	-1.830 <sup>c</sup>
60	-0.0029	-0.239	-1.558	57.1%	-0.0748	-0.765	0.0172	1.152	-2.141 <sup>b</sup>	58.5%	-0.1279	-1.615
61	-0.0309	-2.348	-2.658 <sup>a</sup>	62.2%	-0.1057	-1.075	-0.0051	-0.441	-1.983 <sup>b</sup>	57.9%	-0.1329	-1.669 <sup>c</sup>
62	0.0035	0.266	-0.642	52.9%	-0.1023	-1.041	-0.0089	-0.803	-1.507	56.0%	-0.1418	-1.748 <sup>c</sup>
63	-0.0179	-1.625	-2.108 <sup>b</sup>	59.7%	-0.1202	-1.207	-0.0195	-2.132	-2.300 <sup>b</sup>	59.1%	-0.1613	-1.955 <sup>c</sup>
64	-0.0097	-0.607	-2.842 <sup>a</sup>	63.0%	-0.1299	-1.282	-0.0159	-1.734	-1.983 <sup>b</sup>	57.9%	-0.1773	-2.113 <sup>b</sup>
65	-0.0204	-1.971	-2.842 <sup>a</sup>	63.0%	-0.1503	-1.471	0.0005	0.050	-0.714	52.8%	-0.1768	-2.134 <sup>b</sup>
66	-0.0059	-0.414	-1.558	57.1%	-0.1561	-1.521	-0.0073	-0.750	-2.300 <sup>a</sup>	59.1%	-0.1840	-2.206 <sup>b</sup>
67	0.0017	0.153	-1.008	54.6%	-0.1544	-1.497	-0.0151	-1.345	-2.776 <sup>a</sup>	61.0%	-0.1991	-2.349 <sup>a</sup>
68	-0.0244	-2.159	-2.842 <sup>a</sup>	63.0%	-0.1788	-1.730 <sup>c</sup>	-0.0022	-0.213	-1.031	54.1%	-0.2013	-2.370 <sup>a</sup>
69	0.0052	0.438	0.642	47.1%	-0.1737	-1.674 <sup>c</sup>	-0.0224	-2.120	-1.983 <sup>a</sup>	57.9%	-0.2237	-2.610 <sup>a</sup>
70	-0.0187	-1.445	-2.292 <sup>b</sup>	60.5%	-0.1924	-1.836 <sup>c</sup>	-0.0120	-1.199	-1.824 <sup>b</sup>	57.2%	-0.2357	-2.693 <sup>a</sup>
71	-0.0089	-0.695	-0.642	52.9%	-0.2013	-1.887 <sup>c</sup>	-0.0118	-0.759	-2.776 <sup>a</sup>	61.0%	-0.2475	-2.832 <sup>a</sup>
72	-0.0338	-2.526	-2.842 <sup>a</sup>	63.0%	-0.2351	-2.179 <sup>b</sup>	-0.0083	-0.774	-0.714	52.8%	-0.2558	-2.915 <sup>a</sup>
73	-0.0147	-1.139	-1.558	57.1%	-0.2498	-2.280 <sup>b</sup>	-0.0001	-0.010	-1.190	54.7%	-0.2559	-2.916 <sup>a</sup>
74	-0.0213	-2.114	-3.575 <sup>a</sup>	66.4%	-0.2711	-2.474 <sup>c</sup>	-0.0028	-0.263	-0.714	52.8%	-0.2587	-2.930 <sup>a</sup>

- a significant on a 1%-Level  
b significant on a 5%-Level  
c significant on a 10%-Level

Table 13: Classification of Underwriters

Ranking of Underwriters according to reputation based on an issuer oriented and domestically biased measure (SM), on an investor oriented measure (EM) and an Index based on the equal weighting of the two previous measures.

	Simon Measure (SM)		Euromoney Poll (EM) <sup>2</sup>	
	Total Amount	% <sup>1</sup>	1999	2000
<b>Bankhaus Hauck&amp;Aufhäuser</b>	7,568,000	0.03%	0.00	0.00
<b>Bankhaus Delbrück</b>	8,000,000	0.03%	0.00	0.00
<b>KLM Equity Wertpapierhandelsbank</b>	11,434,365	0.05%	0.00	0.00
<b>Hambrecht &amp; Quist</b>	14,974,280	0.07%	0.00	0.00
<b>ICE Securities</b>	15,350,000	0.07%	0.00	0.00
<b>Berliner Effectengesellschaft</b>	20,730,160	0.09%	0.00	0.00
<b>Schmidtbank</b>	26,450,000	0.12%	0.00	0.00
<b>Trigon Wertpapierhandelsbank</b>	36,500,000	0.16%	0.00	0.00
<b>Kling, Jelko &amp; Demel</b>	40,764,040	0.18%	0.00	0.00
<b>Merck Fink &amp; Co</b>	50,787,500	0.22%	0.00	0.00
<b>Baader Wertpapierhandelsbank</b>	59,864,783	0.26%	0.00	0.00
<b>Hamburger Landesbank</b>	62,700,000	0.27%	0.00	0.00
<b>Landesbank Rheinland-Pfalz</b>	100,800,000	0.44%	0.00	0.00
<b>WGZ-Bank</b>	38,675,000	0.17%	0.05	0.16
<b>MM Warburg &amp; Co</b>	141,964,000	0.62%	0.00	0.00
<b>Concord Effecten</b>	188,319,825	0.82%	0.00	0.00
<b>Norddeutsche Landesbank</b>	191,195,000	0.83%	0.00	0.00
<b>Robertson Stephens</b>	246,111,350	1.07%	0.00	0.00
<b>Landesbank Baden-Württemberg</b>	305,977,713	1.33%	0.00	0.00
<b>Baden-Württembergische Bank</b>	483,600,069	2.11%	0.00	0.00
<b>Gontard &amp; Metallbank</b>	338,818,943	1.48%	0.16	0.11
<b>BHF-Bank</b>	614,987,995	2.68%	0.00	0.00
<b>Bayrische Landesbank</b>	131,512,146	0.57%	0.29	0.57
<b>Bankhaus Sal. Oppenheim</b>	650,202,702	2.83%	0.01	0.10
<b>Vontobel Securities</b>	419,897,813	1.83%	0.37	0.33
<b>GZ-Bank / SGZ-Bank</b>	1,137,145,000	4.95%	0.00	0.00
<b>Henry Schoeder Ltd.</b>	61,237,500	0.27%	0.72	NA
<b>Robert Flemming</b>	71,158,000	0.31%	0.81	0.86
<b>Societe Generale/SG Cowen</b>	41,680,196	0.18%	0.88	0.84
<b>Lehman Brothers</b>	51,750,000	0.23%	0.93	0.87
<b>ABN Amro</b>	62,100,000	0.27%	0.94	0.92
<b>JP Morgan</b>	135,490,000	0.59%	0.97	0.91
<b>Salomon, Smith, Barney</b>	190,198,868	0.83%	0.96	0.97
<b>Merrill Lynch</b>	160,692,500	0.70%	0.98	0.98
<b>BNP Paribas</b>	348,883,261	1.52%	0.92	0.87
<b>HSBC</b>	448,568,680	1.95%	0.91	0.84
<b>UBS Warburg / SMH</b>	376,891,000	1.64%	1.00	0.93
<b>Credit Suisse First Boston</b>	567,326,843	2.47%	0.95	0.94
<b>WestLB Panmure</b>	1,105,561,080	4.82%	0.68	0.74
<b>Morgan Stanley Dean Witter</b>	853,931,106	3.72%	0.97	0.99
<b>HypoVereinsbank</b>	1,519,295,082	6.62%	0.78	0.83
<b>DG Bank</b>	1,877,032,328	8.18%	0.71	0.71
<b>Commerzbank</b>	1,962,087,274	8.55%	0.84	0.79
<b>Deutsche Bank</b>	1,894,842,370	8.25%	0.99	1.00
<b>Dresdner Bank</b>	2,944,046,550	12.82%	0.93	0.88
<b>Goldman Sachs</b>	2,909,088,186	12.67%	0.97	0.96
mean		2.13%	0.40	0.39
STD		3.21%	0.44	0.43

<sup>1</sup> Amounts jointly offered are divided by the number of lead managers and the banks fraction added to 1

<sup>2</sup> Based on annual poll of polls of the Euromoney magazine

Table 6a: Post-IPO Performance categorized by Underwriter Reputation (Part 2, cont'd from main part of the paper)

VC and NVC sample are divided into two portfolio each based on IPOs underwritten by banks with high reputation (VC/HR and NVC/HR) and low reputation, respectively (VC/LR and NVC/LR).

<b>Euromoney Measure (EM)</b>				<b>Simon Measure (SM)</b>			
		<b>NVC/HR</b>	<b>VC/LR</b>			<b>NVC/HR</b>	<b>VC/LR</b>
<b>Panel A2: 24 trading weeks, CAR NEMAX</b>							
		49	100			86	77
<b>VC/HR</b>	33	(0.2911;0.2070) [0.188097;0.0460] {0.575;0.681}	(0.2911;0.1463) [0.1881;-0.0277] {1.127;1.154}	56	(0.1524;0.1503) [0.0486;-0.0043] {0.019;0.081}	(0.1524;0.2039) [0.0486;0.0441] {0.457;0.385}	
<b>NVC/LR</b>	130	(0.1268;0.2070) [-0.0041;0.0460] {0.763;0.742}	(0.1268;0.1463) [-0.0041;-0.0277] {0.234;0.073}	93	(0.1474;0.1503) [0.0369;-0.0043] {0.031;0.160}	(0.1474;0.2039) [0.0369;0.0441] {0.578;0.398}	
<b>Panel B2: 50 trading weeks, CAR NEMAX</b>							
		48	96			85	67
<b>VC/HR</b>	33	(0.1577;0.1776) [0.2138;0.1684] {0.104;0.024}	(0.1577;0.2187) [0.2138;0.2377] {0.338;0.353}	52	(0.1439;0.1564) [0.1197;0.0833] {0.083;0.047}	(0.1439;0.2469) [0.1198;0.2987] {0.647;0.679}	
<b>NVC/LR</b>	129	(0.1869;0.1776) [0.1677;0.1684] {0.069;0.147}	(0.1869;0.2187) [0.1677;0.2377] {0.278;0.461}	92	(0.2103;0.1564) [0.2421;0.0833] {0.444;0.809}	(0.2103;0.2469) [0.2421;0.2987] {0.283;0.437}	
<b>Panel C2: 74 trading weeks, CAR NEMAX</b>							
		46	87			80	67
<b>VC/HR</b>	32	(-0.004;0.2538) [0.1496;0.2242] {1.147;1.031}	(-0.0044;0.1476) [0.1496;0.0905] {0.701;0.608}	52	(-0.0770;0.1058) [-0.0897;-0.0347] {1.025;0.919}	(-0.077;0.2494) [-0.0897;0.1828] {1.699 <sup>c</sup> ;1.647 <sup>d</sup> }	
<b>NVC/LR</b>	113	(0.1374;0.2538) [0.0258;0.2242] {0.696;0.921}	(0.1374;0.1476) [0.0258;0.0905] {0.072;0.183}	79	(0.2371;0.1058) [0.1503;-0.0347] {0.866;0.987}	(0.2371;0.2494) [0.1503;0.1828] {0.074;0.109}	

The first figure in each bracket is referring to the sample as labelled at the beginning of each row; the second figure as labelled at the top of each column. Mean returns are given in parenthesis, median returns in square brackets. The first figure in curly brackets gives t-statistic of difference-in-means test, second figures gives result of Mann-Whitney U-Test for difference-in-medians.

The number of firms in each portfolio is provided in the first row / column in each panel.

- <sup>a</sup> significant on a 1%-Level  
<sup>b</sup> significant on a 5%-Level  
<sup>c</sup> significant on a 10%-Level  
<sup>d</sup> significant on a 15%-Level

High Reputation is defined as:

Euromoney Measure: Reputation index > 0.9

Simon Measure: Market share of lead underwriter > 5%

Table 14: Abnormal Returns and Cumulative Abnormal Return [-2;2]

Event Date	Total Sample			VC			NVC		
	AR	N/N	CAR	AR	N/N	CAR	AR	N/N	CAR
<b>Panel A: Compulsory Lock-Up Period only</b>									
	<b>N = 307</b>			<b>N = 129</b>			<b>N = 178</b>		
-2	0.169%	57%	0.17%	-0.91%	57%	-0.91%	0.949%	51%	0.95%
	(0.945)	{0.868}		(-1.869)	{-1.580}		(2.663)	{2.334}	
	[0.574]			[-3.152]			[3.331]		
-1	-1.143%	58%	-0.97%	-1.97%	59%	-2.88%	-0.543%	56%	0.41%
	(-6.408)	{-3.384}		(-4.058)	{-3.124}		(-1.525)	{0.157}	
	[-3.891]			[-3.615]			[-0.738]		
0	-0.409%	54%	-1.38%	-0.70%	62%	-3.58%	-0.196%	54%	0.21%
	(-2.290)	{-1.084}		(-1.444)	{-0.352}		(-0.551)	{-0.597}	
	[-1.391]			[-2.090]			[-0.757]		
1	0.010%	55%	-1.37%	0.16%	57%	-3.42%	-0.097%	58%	0.11%
	(0.054)	{0.497}		(0.322)	{1.538}		(-0.272)	{1.099}	
	[0.033]			[1.460]			[-0.466]		
2	-0.145%	53%	-1.52%	-0.20%	57%	-3.63%	-0.102%	54%	0.01%
	(-0.812)	{1.072}		(-0.421)	{0.656}		(-0.285)	{0.283}	
	[-0.493]			[-0.375]			[-0.117]		
	<b>Difference in CARs:</b>			<b>1.914</b>			<b>1.664</b>		
<b>Panel B: Full Lock Up Period</b>									
	<b>N = 280</b>			<b>N = 122</b>			<b>N = 158</b>		
-2	-0.003%	49%	-0.00%	-0.646%	59%	-0.65%	0.481%	49%	0.48%
	(-0.018)	{1.455}		(-1.238)	{-0.192}		(1.221)	{1.435}	
	[-0.015]			[-2.241]			[1.594]		
-1	-0.959%	52%	-0.96%	-2.334%	64%	-2.98%	0.076%	52%	0.56%
	(-5.235)	{-4.138}		(-4.470)	{-3.567}		(0.193)	{0.919}	
	[-4.189]			[-4.788]			[0.738]		
0	0.159%	49%	-0.80%	-0.837%	58%	-3.82%	0.910%	49%	1.47%
	(0.870)	{0.328}		(-1.603)	{-0.585}		(2.309)	{0.982}	
	[0.696]			[-2.830]			[1.314]		
1	-0.324%	50%	-1.13%	-0.440%	56%	-4.26%	-0.236%	54%	1.23%
	(-1.767)	{-0.968}		(-0.843)	{-0.119}		(-0.599)	{-0.655}	
	[-1.414]			[0.068]			[-1.007]		
2	0.073%	49%	-1.05%	0.344%	52%	-3.91%	-0.132%	53%	1.10%
	(0.396)	{0.373}		(0.660)	{0.958}		(-0.336)	{-0.856}	
	[0.317]			[0.756]			[-0.260]		
	<b>Difference in CARs:</b>			<b>2.818</b>			<b>2.051</b>		

Normal t-statistics in parenthesis, Brown/Warner-modified t-statistics in brackets, non-parametric Corrado t-statistics CTS<sub>t</sub> in curly brackets

Table 15: Robustness Test for the Impact of the Change in German Speculation Taxes

The Sample is all IPOs with lock-up periods of 6 months or 12 months, respectively, classified by VC backing. An IPO is assigned to the group “Pre” when the lock-up period expired before 1.1.1999 and to “Post” thereafter.

	6 months Lock-Up			12 months Lock-Up		
	Pre	Post	Test <sup>1</sup>	Pre	Post	Test <sup>1</sup>
<b>Panel A: CAR [-2;+2] for expiration of total Lock-Up</b>						
<b>VC</b>	-0.055 <i>-0.077</i>	-0.050 <i>-0.034</i>	0.105 <i>0.906</i>	-0.058 <i>-0.058</i>	-0.004 <i>-0.015</i>	0.606 <i>0.603</i>
<b>N</b>	13	66		2	29	
<b>NVC</b>	0.027 <i>-0.010</i>	0.008 <i>-0.007</i>	0.380 <i>0.208</i>	0.016 <i>-0.003</i>	0.007 <i>-0.008</i>	0.227 <i>0.339</i>
<b>N</b>	11	52		13	74	
<b>Difference Test<sup>2</sup></b>	1.307 <i>1.043</i>	1.957 <sup>c</sup> <i>1.363</i>		0.902 <i>0.764</i>	0.356 <i>0.194</i>	
<b>Total</b>	-0.017 <i>-0.021</i>	-0.024 <i>-0.016</i>	0.190 <i>0.451</i>	0.006 <i>-0.003</i>	0.004 <i>-0.015</i>	0.069 <i>0.129</i>
<b>Panel B: CAR [-4;+15] for expiration of total Lock-Up</b>						
<b>VC</b>	-0.096 <i>-0.081</i>	-0.021 <i>-0.016</i>	0.993 <i>1.130</i>	-0.087 <i>-0.087</i>	0.009 <i>0.004</i>	0.451 <i>0.442</i>
<b>N</b>	13	66		2	29	
<b>NVC</b>	0.060 <i>0.060</i>	0.002 <i>0.022</i>	0.698 <i>0.516</i>	-0.024 <i>-0.051</i>	0.017 <i>-0.012</i>	0.630 <i>0.708</i>
<b>N</b>	11	52		13	74	
<b>Difference Test<sup>2</sup></b>	2.106 <sup>b</sup> <i>1.912<sup>c</sup></i>	0.476 <i>0.648</i>		0.494 <i>0.425</i>	0.146 <i>0.136</i>	
<b>Total</b>	-0.024 <i>-0.041</i>	-0.011 <i>0.004</i>	0.233 <i>0.563</i>	-0.032 <i>-0.070</i>	0.014 <i>-0.007</i>	0.723 <i>0.864</i>

first row gives means, median in second row in italics

1 upper figure gives ANOVA F-Test of difference in means, lower figure van-der-Warden Z-Score for difference in medians

2 upper figure gives T-Test for difference in means, lower figure in italics is Mann-Whitney Test for difference in medians

a significant on a 1%-level  
b significant on a 5%-level  
c significant on a 10%-level