Research Department **Bank of Israel**

Venture Capital Funds and Post-IPO Performance in Booms and Busts: Evidence from Israeli IPO's in the US in the 1990s[1]

by

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Discussion Paper No. 2003.12
September 2003

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[1] We are extremely grateful to Vladimir Lifschitz for his extraordinary contribution to the construction of the database, and to Konstantin Kosenko for excellent research assistance. We also thank Gil Avnimelech, Marco Da Rin, Saul Lach, Sigal Ribon, Yona Rubinstein, Efrat Tolkowsky, Manuel Trajtenberg, Oved Yosha, Haim Zazak and seminar participants at the Bank of Israel and Tel Aviv University for very helpful comments.

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Abstract

This paper evaluates the ability of VC funds to identify and bring to market successful high-tech Israeli companies during the period 1991 to 2000. Using a newly constructed and highly detailed database we find that: (1) According to stock returns and other measures, the post-IPO performance of VC-backed companies did not differ from that of non-VC companies, throughout the 1990s. Furthermore, we show that the entire *distributions* of stock returns among VC-backed and other firms are identical. (2) The probability of survival until the IPO stage was higher for VC-backed companies. We interpret this as evidence that an important contribution of VC funds may be in increasing the survival rates of young technology-intensive firms, rather than in identifying high performers.

JEL Classification: G20, G30.
Keywords: Venture capital, IPO, survival rate, long-run underperformance.

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I. Introduction

The role of VC funds in financing innovative activities is well documented in the literature (e.g., Gompers and Lerner, 1999). In the presence of severe informational problems regarding the quality of innovative young firms, VC funds are often described as capable of identifying promising startups, monitor their progress and advise their management until they reach maturity. By contrast, banks may be reluctant to finance risky early stage activities, and stock markets are typically unable to provide funding to very young companies. VC activity is therefore of particular importance in this respect.

During the last decade, Israel has become a success story of high technology startups and venture capital activity. The venture capital (VC) industry in Israel has undergone dramatic changes, evolving from a small, government-sponsored sector in the early 1990s, into a booming private industry with over 100 active funds, investing billions of dollars per annum in the late 1990s. According to some accounts, VC activity in Israel in the 1990s was one of the highest in world, exceeded only by California and Massachusetts (Mayer, Schoors, and Yafeh, 2002). Government policy in support of the infant VC industry in Israel has often been described as extremely successful (e.g. Avnimelech and Teubal, 2002), and technology startups have transformed the economic landscape of Israel, and constituted an important source of growth in the 1990s (Bank of Israel Annual Reports, various years).

The present study attempts to contribute to the VC literature by proposing a hitherto little explored contribution of VC funds to economic growth. We use a newly constructed database containing detailed information on *all* VC funds operating in Israel and on their *entire* portfolios of client companies, which provides a unique opportunity to observe both pre-IPO survival rates and post-IPO performance. We

examine two main questions: First, do VC-backed firms have a relatively high probability of survival during early stages in their life, and, second, do VC funds bring to the market the most promising firms. To the best of our knowledge, with the exception of Manigart (2003), an analysis of survival rates has not been attempted before. Our main finding is that, in comparison with other high-tech firms, the probability of survival is significantly higher among VC-backed companies, even though their observable characteristics are not very different from those of non-VC backed companies.

While we are not the first to examine the relative post-IPO returns of VC-backed companies, a novelty here is the comparison of the entire *distribution* of returns among VC-backed and other high-tech IPO's. This comparison is important for understanding the economic contribution of VC funds. For example, do they support both the very best and the very worst IPO's? In addition, we distinguish between two "cohorts:" IPO's of the early 1990s (1991 through 1995) and IPO's of the boom years (1996 through 2000). This distinction can shed light on the activities and incentives of VC funds during market upturns and downturns. Using data on stock returns for a period of 36 months for Israeli IPO's on NASDAQ, we find that the performance of VC-backed IPO's during the 1990s has been very similar to that of non-VC-backed IPO's. Moreover, it is impossible to reject the hypothesis that the entire *distribution* of returns among VC-backed IPO's is identical to the distribution of returns among non-VC-backed issues. This implies that VC finance is not associated with superior stock returns; at the same time, our findings also imply that VC funds did not abuse their reputation and support "lemon IPO's."[1]

[1] Our findings are consistent with those of Brav and Gompers (1997), who report inconclusive results on the relative performance of American VC-backed and other IPO's.

In addition to stock returns, we also examine other measures of post-IPO performance such as measures of accounting profitability or asset growth rates. In line with the results on stock return, we find no evidence to suggest that VC finance is associated with superior post-issue performance according to any of these measures.

Taken together, our interpretation of the survival rate and post-IPO performance results is that a plausible contribution of the VC industry to economic growth is in the reduction of mortality rates among high-tech firms (perhaps through monitoring and guidance). We find more evidence for this contribution than for the conjecture that VC funds identify extraordinary firms with extremely high stock returns. While it is possible that VC funds select promising firms on the basis of unobservable characteristics, we argue that this is unlikely to explain our results. Most (though not all) of the processes of this sort would produce differences in the distribution of post-IPO returns between (surviving) VC-backed and other companies, which do not exist in the data. In addition, our conclusions remain unchanged when we control econometrically for the possibility that VC's select "strong survivors." Our findings can therefore be summarized using an analogy from another field: it is not true that "students" of the VC "school" achieve the highest exam scores (rates of return); their grades appear to be similar to those of other "students" (firms). However, the probability of reaching the "high school graduation stage" (IPO) is much higher for VC clients, and this may be their main contribution to social welfare.

As a byproduct of our empirical analysis, we document important changes in the market structure of the VC industry in Israel, arguing that the period of booming high-technology stocks in the late 1990s brought about substantial entry into the industry. We also find that the sharp decline in US stock markets in recent years has reversed the entry and de-concentration trends in the Israeli VC industry. A surprising

finding that emerges from the data on VC activity is that despite the sharp decline in technology share prices, the funds have invested in as many as 330 new firms since 2000. This large number, both in absolute terms and in relation to the VC's portfolios, suggests that the VC industry in Israel is still very much "alive".

The present study is related to the large literature on the economic roles of the VC industry (e.g. Gompers and Lerner, 1999 and 2001; Hellman, 1998 and Hellman and Puri, 2000). It is also related to studies of post-IPO performance of high-technology companies such as Brav and Gompers (1997) and Blass and Yafeh (2001), and to studies comparing the long-run performance of IPO firms more generally (most notably, Ritter, 1991). Also related is the study of Jain and Kini (1995), who, in contrast with our results, find superior post-IPO accounting performance of VC-backed firms in the US, as well as higher initial valuations. Manigart (2003) examines the survival rate and some operating measures of performance for VC-backed and other (unlisted) Belgian firms. Her results also differ from ours: VC-backed Belgian start-ups do not have higher survival rates, but, at least some of them, do grow faster (prior to the exit stage), albeit with higher volatility. Engel and Keilbach (2002) find faster growth for German-backed VC companies (also prior to the exit stage), but not higher patenting rates. Examining companies listed on Europe's "new markets," Botazzi and Da Rin (2002) do not find any evidence to suggest that VC-backed companies fare better than other high-tech companies in terms of growth rates or stock prices. Overall, our study fits into the existing literature, which has not been able to show unambiguously that VC-backed firms do "better" than their peers.

The rest of the paper is organized as follows. The next section describes the database used for this study, provides some background information on VC activity in Israel since the early 1990s, and on the changes over time in the market structure of

this sector. In Section III we compare the attributes of VC client firms with other high-technology companies, and discuss their survival rates. Section IV contains the bulk of our empirical analysis, comparing the post-IPO stock returns and other measures of performance for VC and non-VC-backed issues. Further discussion of the results and some conclusions are offered in Section V.

II. Data Sources

The data used are from a combination of two data sets. The first is that used in Ber (2003), extended and updated through 2002, and containing information on all the start-ups that were included in the portfolios of all Israeli VC funds at any point between 1997–2002 (similar data for earlier years are unavailable). The database provides detailed information on each company supported by a VC during the period, including its line of business, firm characteristics, and status (on-going with VC support, closed/deleted from the VC's portfolio, or performed an "exit:" IPO, private sale, or merger). Because most of those companies are private, this information is not available to the general public, and was gathered primarily from reports of the Israel Venture Capital Association (IVA), to which all Israeli VC funds report. Alongside these data, information was collected for a control group of about 200 high-tech companies that were not supported by an Israeli VC fund and raised capital from other non-VC sources, primarily from investment companies that focused on financing high technology, but were not organized as VC funds. (Data are also from the Israel Venture Capital Association). We use these data to examine the pre-IPO characteristics and survival rates of VC-backed companies in comparison with other high-technology startups.

The second database we use is constructed by the Bank of Israel and contains information on the stock performance of all Israeli high-tech companies listed on NASDAQ. This information is used to compare the post-IPO stock returns for VC-backed and other IPO's that went public between 1991 and 2000.

The matching of the two data sets raises some concerns, because the pre-IPO characteristics and survival rates of VC-backed and other companies refer to the period 1997-2002, whereas our IPO cohorts are from 1991 to 2000. The discussion and conclusion that follow are based on the plausible assumption that the differences in survival rates between VC-backed and other high-tech companies are a general phenomenon, which applies to other time periods as well.[2]

The VC Industry in Israel

We briefly review the evolution of the VC industry in Israel; for further details, see Avnimelech and Teubal (2002) and Ber (2003). In contrast with venture capital markets elsewhere, Israel's VC market was created as a result of the initiative and direct involvement of the government. Following the Research and Development Law of 1985, it was decided in 1991 to support the establishment of VC funds in Israel by providing government guarantees for the purchase of shares in funds via the "Inbal" government insurance company. In this framework, three VC funds were founded in 1991–93 and their investments were guaranteed by the state. In 1992, the "Yozma" government VC fund was set up in order to establish VC funds in cooperation with private foreign investors, and was allocated equity of $ 100 million. Until its dissolution, the fund, which was set up for a limited period of seven years, supported the establishment of ten private VC funds, which together raised a total of $ 2.7 billion

[2] This assumption seems plausible given that the database we use for the analysis of the pre-IPO survival rate covers 26 of the 38 IPO's during the overlapping period of 1997-2000. The remaining 12 companies must have been financed through non-VC entities which are not included in our control sample.

by 2000. At present, the government is no longer involved in the VC industry, which is comprised entirely of private entities. By mid-2000 Israel's VC funds—which are registered with the Registrar of Companies—managed $5 billion of capital via 62 management companies, controlling 97 funds. Finance raised by the funds in 2000 amounted to 2.7 percent of GDP—a particularly high rate compared to other countries (in the US, for example, it was 0.7 percent of GDP at that time). This ratio declined in 2001 and 2002 due to the sharp fall in financial markets, but remained relatively high even during these years: 1.8 and 1 percent, respectively. For further information on the sectors and stages of companies receiving VC finance in Israel, and on the organization of VC activity (sources of finance, fund type, contracts between VC funds and recipient companies, etc.), see Ber (2003) and Mayer, Schoors, and Yafeh (2002).

Despite the large number of VC funds operating in Israel, for most of the 1990s, the market was characterized by a relatively high level of concentration, with the five largest funds managing about 25 percent of the industry's capital. However, Table 1 suggests that the booming years of the late 1990s led to significant entry and de-concentration of the VC industry. The sharp fall in financial markets since 2000 increased the incentive of funds to merge and consolidate their activities; although it seems that changes in this direction have so far not been very large, the preceding trend of de-concentration and entry seems to have been reversed.

III. Recipients of VC Finance and their Survival Rates

Panel A of Table 2 presents some descriptive statistics on high-tech companies in the portfolios of VC funds and non-VC investment companies between 1997 and 2000. The two samples appear to be quite similar in terms of age, median (though not

mean) size, and, with some exceptions, type of activity. Panel B presents probit regressions attempting to characterize the recipients of VC finance. The predictive power of these regressions is poor, and the number of correct predictions is very close to the number that could be predicted by simply using the proportion of VC-backed firms in the sample. We conclude that it is hard to predict who will receive VC finance based on observable firm characteristics.

Table 3 describes changes in the portfolios of VC funds and other investment companies. A striking feature of Panel A is that the fraction of companies deleted from the portfolio of VC funds between 1997 and 2002 (about a quarter) is less than half the corresponding figure for non-VC investment companies, where over half of the portfolio has been deleted, mostly between 2000 and 2002. Panel B shows that, controlling for firm characteristics, the probability of being deleted from the portfolio of a non-VC investment company during the period 1997-2002 was significantly higher than the probability of being deleted from the portfolio of a VC fund. In addition, the probability of reaching the exit stage was also higher for VC-backed firms. Taken together, we view this as evidence of a higher survival rate among VC client firms.

For completeness' sake, we also document new companies added to the portfolios of VC and other non-VC investment companies between 2000 and 2002. We find that a large number of new start-up companies that received funding; during the recent difficult two years, VC funds provided finance to nearly 330 firms! We interpret this as evidence that the VC industry is very much alive despite the recession in Israel and the falling technology stock prices in the US.

IV. The Post-IPO Performance of VC-backed and Other IPO's

Comparisons of Mean and Median Stock Returns for VC-backed and other IPO's

We now turn to the main part of our empirical analysis, a decade-long comparison of stock returns for the first three years following the NASDAQ IPO of VC-backed and other Israeli high-tech companies.[3]

Post-IPO stock returns are calculated using two different methods described in Ritter (1991). In both methods, the excess (or abnormal) return for firm *i* in month *t* after the IPO is defined as the difference between the return on the firm's equity and the market (NASDAQ) return. Both calculations ignore the return on the first day of trading, which are typically highly positive due to the well-documented phenomenon of "underpricing."

In the first approach, we calculate "buy and hold" cumulative abnormal returns for 36 months following the IPO under the assumption that the shares bought at the IPO are held for the entire period. For each company we calculate cumulative returns in excess of the NASDAQ index for a three-year period, and then calculate the (simple) mean and median returns for the sub-samples of VC and non-VC-backed IPO's.

The second calculation method proceeds as follows. Again, we begin by calculating abnormal returns for each company in every month *t*, where *t* equals 1 to 36: $ar_{it} = r_{it}-r_{mt}$, where r_{it} is the return on company *i*'s stock in month *t* and r_{mt} is the NASDAQ index return in the same month. We then calculate the (simple) average (or median) abnormal return for every month *t*, AR_t, for the sub-sample of VC-backed companies and for the sub-sample of non-VC-backed companies separately. For each

[3] We focus on NASDAQ rather than on local IPO's because this is where Israel's best high-tech companies typically "exit." In the late 1990s, the number of Israeli companies listed on NASDAQ exceeded the number of all other foreign firms combined (excluding Canadian companies). Virtually all of the Israeli companies on NASDAQ are in high-tech industries. See also Blass and Yafeh (2001).

of the two sub-samples, we define the (average) cumulative abnormal returns, CAR_t as the sum of the average abnormal returns, AR_t from month 1 to month t. Note that this method assumes "re-balancing" of the portfolio every month, so that gains or losses in previous months are ignored, and each month begins with an equal investment in all IPO cohorts.[4]

Tables 4 and Figure 1 present the estimated cumulative excess returns (CAR) for VC-backed and other companies for 36 months according to the "buy and hold" method; the results for the second calculation are relegated to the Appendix. In line with the well-documented phenomenon of long-run under-performance of IPO shares (Ritter, 1991) the returns on both groups of issues fell far below the NASDAQ index.[5] More interestingly, there is little to suggest that VC-backed IPO's out-performed other issues. According to the calculation presented in Table 4, VC-backed IPO's fared better than their non-VC-backed peers, but the variance within each sample is so high that it is impossible to reject the null hypothesis that the mean and median CAR are in fact equal. These findings appear to be robust. The absence of significant differences in post-IPO stock returns between VC-backed and other IPO's is found also in the second CAR calculation (see Appendix), as well as when the IPO sample is divided into two cohorts, the first half of the 1990s and the "boom years" (1996-2000). VC-backed IPO's never exhibit higher and statistically significant IPO returns.

[4] For the derivation of standard errors for these statistics, see Ritter (1991). Our calculations are based on simple means rather than on size-weighted averages. This is because of the sample size and the difficulty in assigning size-based weights to IPO's in different time periods. There are several additional methods to calculate excess returns, which we do not apply here. It is possible to calculate cumulative abnormal returns relative to the returns predicted by the CAPM model; we do not apply this method here because it is difficult to calculate betas for newly listed firms. It is also possible to calculate returns relative to some "reference portfolio" (e.g. Brav and Gompers, 1997). This method is not feasible in our case because of the sample size and because of the absence of comparable firms to which Israeli IPO's in the US should be compared.

[5] Ritter (1991) documents lower negative abnormal returns of about –30 percent over a three-year period for his sample of American IPO's. His interpretation of this phenomenon is of a "hot market" effect, whereby firms schedule their IPO's in a period when demand is particularly high, and investors are perhaps "over-optimistic."

Table 5 presents the results of regressions where the dependent variable is each firm average monthly excess return over a 36-month period or its cumulative abnormal return over the same period. The right-hand-side variables include controls for industry and cohort, yet even after controlling for these observable characteristics, there is still no difference between the returns of VC-backed and other IPO's. A specification that takes into account the fact that Tables 4 and 5 are based on "survivors" only, i.e. on firms that "made it" to the IPO stage is discussed later; the results remain qualitatively unchanged.

Comparisons of Risk and Return Distributions

Our estimates so far have detected no systematic differences in long-run mean and median stock returns between VC-backed and other IPO's. We now examine whether the distribution of post-IPO stock returns is different for the two sub-samples. For example, we would like to know if VC funds bring to market both the very best IPO's and the very worst (using their reputation to occasionally fool post-IPO investors and) ending up with average post-IPO returns which are similar to those of non-VC-backed issues, but with a higher variance. Figure 2, which portrays the distribution of returns for the two sub-samples, suggests that this is not the case: there is a striking similarity in the two distributions. More formally, we conduct a test for the equality of the variances of the two sub-samples and cannot reject the hypothesis that the two are equal. Furthermore, stochastic dominance tests (Kolmogorov-Smirnov test of equality of distributions, and Wilcoxon (sum-of-ranks) test) strongly suggest equality of the two distributions: the *p*-values associated with the tests are 0.44 and 0.26, respectively. We conclude that VC-backed IPO's and other high-technology issues are drawn from a similar distribution. However, we have seen before that the rate of survival (the

probability of reaching the IPO stage) is higher among VC-backed firms, an issue to which we will return below.

It is impossible to assess the relative return on VC-backed IPO's without investigating risk as well. First, we examine the standard deviation of the monthly abnormal returns for each firm, and find no difference in this measure of volatility between VC-backed and other IPO's. *Betas* for VC-backed companies are slightly higher than for other IPO's (about 1.1. relative to 0.9, and this difference is statistically significant), so that there is no reason to suspect that VC-backed issues are superior in that they offer lower risk than other technology IPO's.

Other Measures of Post-issue Performance and Sample Selection Issues

So far, we have implicitly regarded long-run post-IPO excess stock returns as a measure of firm performance. It is, of course, possible that differences between VC-backed and other IPO's are fully reflected in the valuation of companies when their shares are offered to the public rather than in long-run stock returns. To examine this issue, we compare market to book ratios for VC-backed and other companies at the end of the IPO year. Controlling for IPO cohort (1996-2000 vs. the early years), we find that VC's have a somewhat higher valuation, but the difference is not statistically significant. Although this is only a rough measure of firm valuation at the time of the IPO, it does not appear to be the case that VC-backed IPO's are initially priced differently than other issues. We conclude that differences in quality between VC-backed and other issues are reflected neither in initial valuation nor in long-run stock returns.

Turning to other measures of post-issue performance, Table 6 suggests that there are virtually no statistically significant differences in accounting measures of profitability (ROA, net profits to assets, and pre-tax profits to assets). Average asset

growth rates are much higher on average for VC-backed IPO's, but as in the case of stock returns, the variance within each subs-sample is high. (The difference in growth rate is significant only at the 10.5 percent level).

Finally, our comparisons of post-issue performance have so far been based on samples of surviving VC-backed and other firms, that "made it" to the IPO stage. Before concluding the empirical analysis, we address the possibility that reconstructing the original distributions of VC-backed and other companies might change our impressions on the relative performance of the two types of firms and on the impact of VC's on post-issue performance. Of course, the identical distribution of post-issue returns among VC-backed and other companies makes it difficult to argue that VC's select (or screen) firms on the basis of some (observable or other) measures of quality. Such selection or screening processes would tend to generate a difference in the distribution of post-IPO stock returns, although admittedly some, rather contrived, alternative explanations for the observed similarity in the distributions are possible. We address this issue as follows. Using the probit regression in Table 3B, which explains the likelihood of survival until the exit stage, we generate for each firm a propensity score (ranging between zero and one) and an Inverse Mills ratio. These should be treated with caution; only 26 of the 89 IPO's in our sample (with IPO dates are between 1997 and 2000) are included in the probit regression (see footnote 2). For the other firms, propensity scores and mills ratios are "fitted values" derived from the coefficients in Table 3B. The results, when these corrections for sample selection are included in the regression, remain unchanged; see Table 7. (The coefficients on the selection variables are insignificant). Even after correcting for the possibility that the sample of firms that reached the IPO stage is non-random, there is no evidence that VC finance is associated with superior "quality" as reflected in stock returns.

V. Discussion and Concluding Remarks

The contribution of VC finance to the development of high-tech industries has been the subject of a large and growing literature. The present study attempts to contribute to this literature by showing that there is little difference in post-IPO performance between VC-backed and other companies: the entire distribution of post-IPO 3-year returns among VC-backed firms is identical to the distribution of performance among other newly listed high-tech firms. Moreover, VC-backed IPO's are not low-risk investments in comparison with other IPO's. A similar picture emerges from accounting measures of post-issue performance. There is however, one important difference between the two samples: the likelihood of survival until the exit stage appears to be much higher for VC clients. This suggests that the provision of assistance to (all) firms in reaching the IPO stage may be *the* contribution of the VC industry, which appears to be unable to consistently select exceptionally high performers. For instance, it is possible to imagine a "disease" with a mortality rate that affects young high-tech firms of *all* types between their inception and the time of their IPO. Our interpretation of the results in this study is that monitoring and support by VC's lower this mortality rate.[6] To the extent that young high-tech companies are an ex-ante positive NPV investment, this constitutes a contribution of the VC industry to economic growth and social welfare.

[6] Some alternative explanations for our findings are possible. For example, VC funds may select firms with high survival rates, but that do not offer higher stock returns if they make it to the IPO stage. If this is the case, it may be possible to argue that the VC industry contributes nothing at all – it only identifies firms that would have survived in any case. Our main point, however, remains valid: to the extent that VC funds do contribute to economic growth, they are likely to do so in reducing mortality rates, rather than in cherry picking. The interpretation we offer implies that VC funds reduce mortality rates among client firms of all types, not just among the very best (or worst) companies. This is quite likely, because ranking new companies in innovative fields may be extremely difficult.

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Table 1

Industrial Organization of the VC Industry over Time: Basic Statistics

	1997	**2000**	**2002**
Number of VC funds	58	101	135
Total amount of capital managed by VC funds (million $)	1,674.7	5,084	10,575
The share of capital managed by the 5 largest funds (%)	36.2	24.8	27.1
The share of capital managed by the 10 largest funds (%)	51.0	36.3	37.7
Herfindahl Index	0.039	0.027	0.025
Number of new funds	-	63	48
Number of closed funds	-	20	14

Table 2

The sample in both panels of consists of the entire population of companies included in the portfolios of VC funds and other investment companies at any time between 1997 and 2000. Age and the number of employees refer to the year 2000.

Panel A: High-tech Firms in the Portfolios of VC Funds and Non-VC Investment Companies

	VC funds	Non-VC Investment Companies
Firms in Portfolio	492	169
% failed (deleted from the portfolio)	5.0	2.5
% "exited" (all forms of exit)	23.2	10.8
% remaining in the portfolio	71.9	86.7
Average Age	7.9	7.1
Median Age	7.0	5.0
No. of employees (avg.)	63.8	146.6
No. of employees (median)	30.0	20.0
Distribution by Industry (%)		
Software and programming	37%	49%
Communication	22%	18%
Computers	1%	0%
Other Technology	15%	16%
Healthcare and Life Science	21%	12%
Other Non-Technology	3%	5%

Panel B: Probit Regressions: Who is Included in the Portfolio of VC Funds?

The dependent variable takes the value of 1 if a firm received VC finance and zero if a firm was financed otherwise. The omitted industry is "non-technological industries." Standard errors appear in parentheses. * and ** denote statistical significance at the 5 and 10 percent levels, respectively.

	VC
Constant	Yes
Age	0.004 (0.03)
Software and programming	0.06 (0.09)
Communication	0.15** (0.09)
Computers	0.35* (0.18)
Other Technology	0.08 (0.09)
Healthcare and Life Science	0.21* (0.09)
McFadden's R-squared	0.03
N	661

Table 3
Changes in the Portfolios of VC Funds and Other Investment Companies
1997 - 2002

Panel A: Firms Deleted from the Portfolio

	VC funds	Non-VC Investment Companies
Deleted from the portfolio (% relative to the total number of firms included in the portfolio at any time between 1997 and 2000)	26.0% (127 Obs.)	49% (83 Obs.)
Average age	7.6	7.3
Median age	6.0	5.0
No. of employees (avg.)	45.9	82.7
No. of employees (median)	20.4	15.0
Distribution of deleted firms by industry (%)		
Software and programming	49%	49%
Communication	21%	18%
Computers	0%	0%
Other Technology	9%	13%
Healthcare and Life Science	18%	10%
Other Non-Technology	4%	10%

Panel B: Probit Regressions Estimating the Survival Rates

VC-backed and Other High-tech Firms

The sample in this panel consists of the entire population of innovative companies included in the portfolios of VC funds and non-VC investment companies at any time between 1997 and 2000. The dependent variable "FAIL" takes the value of 1 if a firm was deleted from the portfolio by 2002, and zero otherwise. EXIT takes the value of 1 if a firm has made an exit during the same 1997-2002 period (IPO, sale, or merger), and zero otherwise. VC equals 1 for VC-backed companies. AGE is years from foundation. The omitted sector is "non-technological industries." Standard errors appear in parentheses. * and ** denote statistical significance at the 5 and 10 percent levels, respectively.

	FAIL	**EXIT**
Constant	Yes	Yes
VC	-0.98* (0.19)	1.42* (0.31)
Age	-0.003 (0.01)	0.13* (0.02)
Software	-0.68 (0.43)	0.5 (0.54)
Communication	-1.03* (0.45)	0.95** (0.55)
Computers	-32.0 (0.0)	33.9 (0.0)
Other Technology	-1.34* (0.47)	0.28 (0.49)
Healthcare and Life Science	-1.13* (0.46)	-0.46 (0.58)
McFadden's R-squared	0.06	0.16
N	661	661

Table 4

Long-run Post-IPO Stock Returns for VC-backed and Other IPO's

"Buy and Hold" Cumulative Excess Returns over the NASDAQ Index

Means and Medians for the Whole Sample

Number of observations for each month: VC-backed = 51, Non-VC-backed=38. None of the differences in medians or means is statistically significant at levels of 10 percent or less.

Month from IPO	Median VC=1	Median VC=0	Significant difference?	Mean VC=1	Mean VC=0	Significant difference?
1	-5.8	-0.8	No	1.7	3.9	No
2	-2.0	-0.9	No	1.1	3.2	No
3	-5.3	-0.7	No	4.5	9.3	No
4	-3.3	-8.8	No	4.8	2.5	No
5	-4.4	-9.5	No	4.1	3.8	No
6	-18.6	-12.3	No	-3.6	2.1	No
7	-22.9	-12.6	No	-0.6	-1.0	No
8	-22.8	-12.6	No	-0.4	-5.5	No
9	-24.6	-16.8	No	-3.8	-9.6	No
10	-29.7	-10.0	No	-2.4	-6.8	No
11	-26.4	-20.7	No	-2.4	-12.5	No
12	-25.6	-25.0	No	-9.5	-15.4	No
13	-30.7	-28.5	No	-7.3	-12.7	No
14	-31.4	-34.5	No	-7.0	-11.8	No
15	-34.4	-42.7	No	-10.8	-15.6	No
16	-35.7	-38.2	No	-12.5	-23.1	No
17	-29.0	-52.5	No	-8.4	-29.0	No
18	-32.2	-65.3	No	2.6	-31.8	No
19	-29.7	-63.0	No	-0.2	-34.5	No
20	-34.7	-62.8	No	-21.2	-32.3	No
21	-44.8	-66.2	No	-18.9	-38.2	No
22	-39.1	-64.5	No	-24.5	-41.0	No
23	-47.9	-63.2	No	-23.6	-44.6	No
24	-53.7	-79.1	No	-40.2	-44.7	No
25	-59.8	-72.2	No	-45.0	-52.9	No
26	-56.6	-82.4	No	-49.2	-51.4	No
27	-60.3	-91.2	No	-58.0	-61.1	No
28	-65.3	-92.4	No	-62.4	-70.1	No
29	-71.2	-99.1	No	-64.6	-77.5	No
30	-74.4	-89.1	No	-61.4	-76.3	No
31	-75.6	-91.8	No	-60.6	-73.1	No
32	-67.3	-106.3	No	-66.1	-77.5	No
33	-77.6	-97.4	No	-71.2	-87.7	No
34	-68.2	-104.0	No	-71.1	-91.7	No
35	-82.0	-104.2	No	-74.3	-91.2	No
36	-69.3	-102.2	No	-71.3	-93.6	No

Table 5

Cross-sectional Excess Returns Regressions

OLS regressions, where the dependent variable is average monthly abnormal return for firm *i* in month t, *t=1 to t=36*, or cumulative "buy and hold" abnormal returns for 36 months, controlling for industry and IPO cohort. Standard errors appear in parentheses. ** denotes statistical significance at the 10 percent level, * significance at the 5 percent level. The omitted industry is "other, non-technology."

	Abnormal Monthly Returns	**Cumulative Buy and Hold Abnormal Returns**
Constant	Yes	Yes
VC	-0.45 (0.76)	12.28 (21.6)
Dummy for 1996-00 IPO's	-0.74 (0.76)	-37.6** (21.55)
Software	2.22* (1.01)	92.9* (28.6)
Communication	2.97 (1.10)	126.80* (31.19)
Computers	1.04 (1.31)	52.32 (37.06)
Other Technology	1.91 (1.23)	32.23 (34.76)
Healthcare and Life Science	-3.54 (2.46)	0.72 (69.43)
R-squared	0.11	0.23
N	89	89

Table 6

Average Accounting Measures of Post-issue Performance

	VC=1	VC=0	Significant difference?
Operating profits to assets (one year after the IPO, N=65)	Mean: -4.6%	Mean: 4.3%	No
	Median: 2.2%	Median: 11.5%	No
Net profits to assets (one year after the IPO, N=68)	Mean: -8.6%	Mean: -2.4%	No
	Median: 0.8%	Median: 8.8%	Yes
Pre-tax profits to assets (one year after the IPO, N=68)	Mean: -10.3%	Mean: -26.5%	No
	Median: 0%	Median: 0.1%	No
Average asset growth three years after the IPO (N=54)	Mean: 69%	Mean: 33%	No
	Median: 35%	Median: 15%	No

Table 7

Cross-sectional Excess Returns Regressions, Controlling for Sample Selection

OLS regressions where the dependent variable is cumulative "buy and hold" abnormal returns for 36 months. The propensity score and mills ratio are based on the exit probit in Table 3B. Standard errors appear in parentheses. ** denotes statistical significance at the 10 percent level, * significance at the 5 percent level. The omitted industry is "other, non-technology." The Inverse Mills ratio cannot be calculated for firms in the computer industry whose propensity score is one

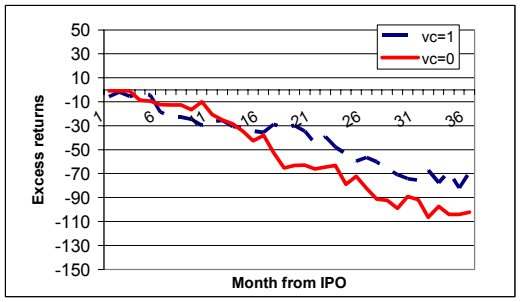
	Cumulative Buy and Hold Abnormal Returns	**Cumulative Buy and Hold Abnormal Returns**
Constant	Yes	Yes
VC	5.52 (24.48)	19.72 (26.76)
Dummy for 1996-00 IPO's	-34.80 (22.07)	-38.22 (24.65)
Propensity Score	330.09 (396.81)	
Inverse Mills Ratio		1.74 (11.94)
Software	83.36* (30.44)	85.72* (31.42)
Communication	123.57* (33.00)	123.40* (34.65)
Computers	41.44 (38.88)	
Other Technology	29.31 (36.12)	25.53 (36.12)
Healthcare and Life Science	17.54 (75.40)	-3.53 (74.56)
R-squared	0.24	0.24
N	86	76

Figure 1

Post-IPO Stock Returns for VC-backed and Other IPO's

"Buy and Hold" Excess Returns over the NASDAQ Index

Median values



Mean values

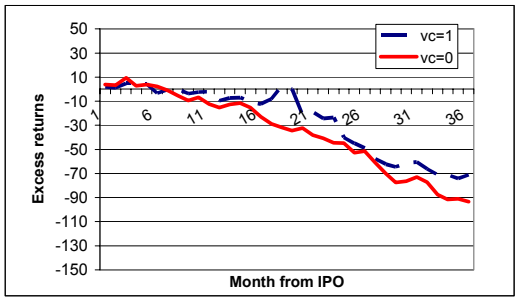
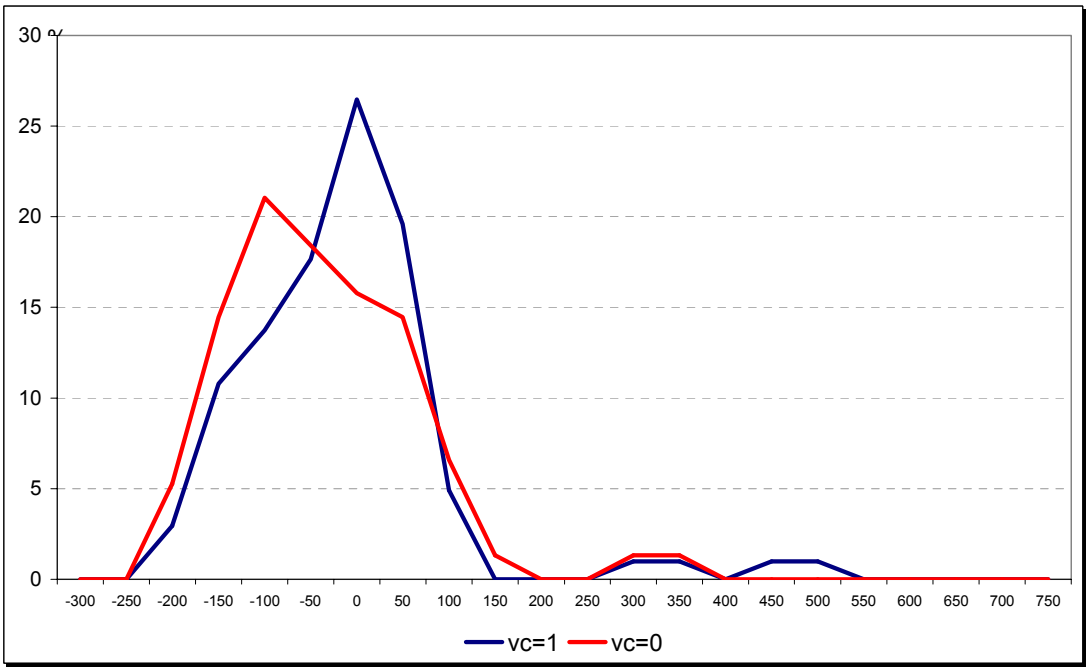


Figure 2

The Distribution of 36 month "Buy and Hold"

CAR's among VC-backed and Other IPO's



Appendix: Alternative Calculation of Long-run Post-IPO Stock Returns with Monthly Re-balancing (see text)

Number of observations for each month: VC-backed = 51, Non-VC-backed=38. None of the differences in medians or means is statistically significant at levels of 10 percent or less.

	Median			Mean		
Month from IPO	**VC=1**	**VC=0**	**Significant difference?**	**VC=1**	**VC=0**	**Significant difference?**
1	-5.8	-0.8	No	1.7	3.9	No
2	-6.7	-3.7	No	3.3	3.8	No
3	-7.0	-2.1	No	7.0	8.5	No
4	-10.4	-9.6	No	8.0	1.3	No
5	-13.0	-13.9	No	6.5	2.4	No
6	-22.5	-17.5	No	1.1	0.0	No
7	-22.9	-17.1	No	3.8	0.2	No
8	-27.2	-19.9	No	5.3	-3.4	No
9	-29.4	-24.0	No	4.7	-6.1	No
10	-31.8	-23.0	No	6.7	-3.4	No
11	-33.7	-28.7	No	7.1	-10.0	No
12	-40.6	-34.1	No	2.2	-15.4	No
13	-41.2	-36.8	No	1.3	-16.3	No
14	-44.9	-40.1	No	1.5	-16.8	No
15	-47.8	-41.8	No	-1.5	-21.2	No
16	-52.4	-49.7	No	-5.4	-30.1	No
17	-52.7	-59.9	No	-2.7	-41.5	No
18	-57.2	-59.6	No	-1.5	-30.7	No
19	-63.3	-61.7	No	-3.4	-32.2	No
20	-63.6	-64.3	No	-6.4	-28.0	No
21	-65.1	-71.6	No	-7.3	-35.9	No
22	-66.0	-75.6	No	-5.9	-37.4	No
23	-65.9	-76.4	No	-8.9	-30.4	No
24	-69.3	-79.6	No	-9.4	-32.9	No
25	-70.0	-86.5	No	-10.6	-35.8	No
26	-68.0	-89.8	No	-5.8	-34.5	No
27	-72.1	-97.2	No	-10.7	-39.0	No
28	-71.8	-97.9	No	-8.4	-27.8	No
29	-71.3	-104.6	No	-7.4	-29.1	No
30	-71.2	-103.8	No	-4.6	-15.3	No
31	-75.6	-112.7	No	-4.8	-5.2	No
32	-79.0	-111.9	No	-7.6	-0.9	No
33	-83.6	-114.4	No	-8.1	0.9	No
34	-85.2	-121.8	No	-1.3	-6.4	No
35	-87.0	-124.0	No	-2.2	4.8	No
36	-87.5	-125.0	No	-3.6	6.0	No