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# THE PRIVATE EQUITY RETURNS: AN EMPIRICAL EXAMINATION OF THE EXIT OF VENTURE-BACKED COMPANIES

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*In this paper, we examine 52 322 financing rounds in 23 208 unique firms, over the period 1980 through 2000 by venture and buyout funds and estimate the probability of exit, time to exit, exit multiples, and the expected gains from private equity investments. The expected multiple (after accounting for dilution and the probability of exit) ranges from a low of 1.12 for late-stage firms to a high of 5.12 for firms financed in their early stages. We find that the gains from venture-backed investments depend upon the industry, the stage of the firm being financed, the valuation at the time of financing, and the prevailing market sentiment. Our study is a first step in understanding the risk premium required for the valuation of private equity investments.*

## 1 Introduction

Little is known about the return characteristics of private equity investments.[1] In a recent review paper, Gompers and Lerner (2000b) cite this as one aspect of "what we don't know about venture capital". Hellman and Puri (2000, 2002) find that innovator firms are usually faster to market than imitator firms, and amongst these, those with venture capatial (VC) backing tend to make it to market even faster. Gompers (1996) shows that young VCs tend to "grandstand", that is, take actions to signal their ability to investors, and hence they tend to be more aggressive in bringing firms to market. In addition, Lerner (1994) has shown that venture capitalists are able to time the market and bring their firms public under favorable conditions. In this article, we summarize the VentureXpert database in a comprehensive manner to bear on this question by estimating the probability of exit, industry-adjusted exit multiples, and expected gains on private equity investments for a large sample of venture-backed investments.

An examination of the exit outcomes of venture-backed financings is a question of interest to both the academic and the practitioner community. First, as Moskowitz and Vissing-Jorgensen (2001) point out, the private equity market is as important as the public market in terms of size and is actually

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larger for most of their sample period. The sheer size alone is reason enough to study the risk–return trade-off in this market. Also, Gompers and Lerner (2000b) assert that this is a critical area of study because when private equity is mixed with public equity in a portfolio, a better understanding of risk and return would result in superior portfolio choice. They believe that the current inability to value and determine the correlation of private firms with public firms imposes a serious impediment to optimal portfolio choice. Prior research estimated private equity performance using a proxy for private firms, such as publicly traded venture funds (Gompers and Lerner, 1997; Martin and Petty, 1983). In contrast, this paper investigates venture-backed companies to shed light more directly on the risk premium required for the valuation of private equity investments.[2]

Second, our study is useful in determining the private company discount. Specifically, many finance professionals struggle with the issue of how to value private companies. Unlike publicly traded companies, a private company has no observable stock price to serve as an objective measure of market value. Investors may typically demand a discount for these investments because they may be unable to sell the asset for a period of time. A number of prior studies have attempted to estimate the lack of liquidity. These studies fall into one of three categories. The first estimates the marketability discount by comparing the price of an asset during a period in which it is non-marketable to a period in which it is marketable. Specifically, they compare share prices of firms in the initial public offerings (IPO) to transaction prices in those same shares prior to the IPO.[3] The second approach compares share prices of two claims on the same underlying asset, where one claim is marketable and the other is not. This approach is typically implemented by comparing the price of restricted stock with freely tradeable securities.[4] The third approach compares acquisition prices of private companies with those of comparable public companies.[5] As Bajaj *et al.* (2001) argue, these approaches have several limitations. We account for some of the possible pitfalls in estimating the private company discount by comparing the valuation of the private firm with the expected value at the liquidity event. Additionally, our approach permits us to estimate the discount for companies in various stages of their growth cycle, industry, and at different points in time. Moskowitz and Vissing-Jorgenssen state that 66% of private companies fail in their first 10-years. All these factors would lead to higher rates of required return on private equity, reflected in the discount charged at the time the venture capitalist invests in these firms. It is important to understand that what we are capturing is more than a non-tradeability discount. The venture capitalists provide an important monitoring and mentoring role to the companies they finance. They often sit on boards of companies in which they invest, and make available their network to these companies. Thus, almost certainly a part of the return is due to these activities.

Our empirical approach is straightforward. We start with a sample of over 52 000 rounds of financing over the period 1980–2000 for which we were able to obtain data from VentureXpert. We follow each of these investments, and estimate the probability of their being acquired or having an IPO. We find that for our sample the probability of an exit via an IPO is roughly 20–25%, and is fairly constant for firms financed in an early stage, expansion stage, or later stage. Similarly, we find the probability of exit via an acquisition is approximately 10–20%. The probability of an acquisition is much higher for the firms financed in later stages. In other recent work covering a smaller period, Gompers and Lerner (1999b) report that, for the period 1983–1994, about 31% of the firms in the VentureOne database completed an IPO and another 29% were acquired. The overall probability of exit increases as we move from early- to late-stage companies. As many as 44% of the companies in late-stage financings experienced a liquidity event, while only 34% of early-stage firms had a successful exit. There is also high cross-sectional variation in the probability of

an exit across different industries. The high-tech, biotech, and medical sectors had a higher probability of successful exit relative to new ventures operating in other sectors. We also find that there is a variation in time to exit across different stages of financing. For over two-thirds of late-stage companies, successful exit happens within 3-years of financing, while only one-third of early-stage companies have a liquidity event within 3-years of financing.

We next estimate the exit multiples obtained for firms that had an IPO or an acquisition/buyout.[6] We find that exit multiples depend upon the stage of financing. For example, the average for early-stage firms that have an IPO is about 21; for firms that have an acquisition/buyout the average is 10.23. Parts of these high multiples are a result of favorable valuation changes in the industry. Once we adjust the multiples for industry performance, the multiples for early-stage companies are 16 and 7, respectively. Also, later-stage investments return an average of four times the initial investment. After adjusting for industry movements, the multiples fall to around 2.5. Also, the multiples for acquired firms are usually much lower than the multiples for IPOs over the same time period and in similar industries. Average multiples for firms being acquired range from 10.2 for early-stage firms to 4.6 for later-stage companies. Also, there is substantial cross-sectional variation in the exit multiples across industries. Firms in the communications, Internet, and semiconductor segments had the highest multiples, followed closely by the firms in the software and hardware segments.

The remainder of the paper is organized as follows. Section 2 discusses our data sources and reports descriptive statistics for the sample transactions. Section 3 reports evidence on the probability of exit categorized by year, industry, and stage of company being financed. Section 4 reports evidence on the exit multiple and Section 5 provides results on the expected private equity gains.

## 2 Sample and data descriptions

### *2.1 Sample selection*

Our sample is obtained from Thompson Financial Data's VentureXpert database. VentureXpert obtains information on private equity investments from over 1000 different companies that make private equity investments. Over 700 of these partner companies are venture funds, while over 250 are buyout and other equity funds. We limit our analysis to the period between 1980 and 2000. We further restrict the study to investments made in US private firms. This selection process results in a sample of 52 322 financing rounds in 23 208 unique firms. We follow these firms till there is an exit or till the end of 2000. The information about the exit is available in the VentureXpert database, and we verify it against the new issue database (for IPOs), and the mergers and acquisitions database (for acquisitions), also provided by Thompson Financial Data Corporation.[7]

### *2.2 Distribution of financing*

Table 1 reports the frequency of financing rounds over time and across industries. Deal flow increases from the 1980s to the next decade. There appear to be cycles in the amount of private equity financing. The period 1986–1990 evidenced large deal flow, which declined in the early 1990s. More recently, the years 1996–2000 comprise a much higher level of financing than evidenced before. For example, in year 2000 we have data on 7386 financing rounds, which is more than double the number of deals financed in any year up to 1997. This increase in the period 1996–2000 is largely a function of increased capital commitments to the so-called "new economy" firms, for example, Internet, communications, hardware and software businesses.

Certain industries have received a large proportion of available private equity financing. The top five industry groups account for over 60% of the total

**Table 1** Frequency of financing rounds

| Industry sector | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *A: 1980–1989* | | | | | | | | | | | |
| Agriculture/forestry/fisheries | 1 | 8 | 10 | 11 | 10 | 9 | 11 | 9 | 7 | 11 | 4 |
| Biotechnology | 20 | 43 | 57 | 70 | 52 | 80 | 103 | 125 | 141 | 140 | 131 |
| Business services | 21 | 22 | 40 | 36 | 29 | 31 | 51 | 57 | 70 | 58 | 52 |
| Communications | 49 | 116 | 139 | 200 | 232 | 241 | 265 | 296 | 256 | 268 | 222 |
| Computer hardware | 109 | 192 | 275 | 367 | 377 | 277 | 263 | 229 | 218 | 215 | 162 |
| Computer other | 0 | 2 | 3 | 3 | 3 | 4 | 3 | 3 | 6 | 6 | 6 |
| Computer software | 19 | 51 | 122 | 221 | 268 | 265 | 275 | 262 | 252 | 279 | 322 |
| Construction | 5 | 10 | 4 | 16 | 10 | 14 | 18 | 14 | 15 | 18 | 13 |
| Consumer related | 50 | 65 | 113 | 132 | 133 | 158 | 195 | 258 | 339 | 330 | 241 |
| Finance/insurance/real estate | 20 | 26 | 35 | 29 | 28 | 39 | 63 | 75 | 82 | 94 | 88 |
| Industrial/energy | 103 | 171 | 193 | 171 | 170 | 168 | 195 | 211 | 219 | 240 | 200 |
| Internet specific | 2 | 3 | 5 | 17 | 15 | 14 | 24 | 30 | 31 | 26 | 28 |
| Manufacturing | 14 | 26 | 63 | 53 | 57 | 32 | 60 | 72 | 109 | 143 | 86 |
| Medical/health | 47 | 64 | 100 | 157 | 186 | 195 | 211 | 276 | 251 | 305 | 292 |
| Other | 2 | 7 | 17 | 11 | 6 | 3 | 2 | 0 | 2 | 9 | 1 |
| Semiconductor/other | 78 | 105 | 118 | 149 | 215 | 199 | 193 | 196 | 178 | 179 | 155 |
| Transportation | 17 | 11 | 19 | 20 | 22 | 22 | 33 | 41 | 52 | 42 | 38 |
| Utilities | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 2 | 5 | 7 | 6 |
| **Total** | 558 | 922 | 1314 | 1663 | 1814 | 1751 | 1965 | 2156 | 2233 | 2370 | 2047 |

| Industry sector | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *B: 1990–2000* | | | | | | | | | | | |
| Agriculture/forestry/fisheries | 5 | 4 | 6 | 8 | 7 | 11 | 8 | 25 | 6 | 9 | 180 |
| Biotechnology | 127 | 150 | 152 | 150 | 132 | 178 | 214 | 246 | 200 | 219 | 2730 |
| Business services | 30 | 31 | 35 | 34 | 38 | 54 | 68 | 127 | 123 | 146 | 1153 |
| Communications | 206 | 292 | 246 | 274 | 277 | 379 | 437 | 553 | 541 | 797 | 6286 |
| Computer hardware | 122 | 131 | 89 | 104 | 112 | 112 | 141 | 144 | 123 | 185 | 3947 |
| Computer other | 9 | 12 | 6 | 3 | 5 | 2 | 7 | 8 | 7 | 10 | 108 |
| Computer software | 304 | 362 | 317 | 341 | 373 | 584 | 773 | 900 | 1012 | 1287 | 8589 |
| Construction | 9 | 4 | 7 | 9 | 5 | 16 | 29 | 34 | 21 | 21 | 292 |
| Consumer related | 158 | 183 | 175 | 193 | 244 | 263 | 362 | 419 | 249 | 201 | 4461 |
| Finance/insurance/real estate | 104 | 74 | 100 | 113 | 120 | 264 | 174 | 235 | 159 | 174 | 2096 |
| Industrial/energy | 134 | 152 | 118 | 117 | 120 | 182 | 210 | 248 | 119 | 116 | 3557 |
| Internet specific | 29 | 35 | 31 | 50 | 108 | 312 | 489 | 700 | 2075 | 3310 | 7334 |
| Manufacturing | 50 | 51 | 52 | 35 | 53 | 61 | 68 | 92 | 68 | 50 | 1295 |
| Medical/health | 237 | 317 | 261 | 276 | 290 | 426 | 497 | 567 | 457 | 453 | 5865 |
| Other | 3 | 3 | 2 | 3 | 6 | 11 | 17 | 88 | 36 | 26 | 255 |
| Semiconductor/other | 117 | 133 | 107 | 105 | 118 | 114 | 169 | 232 | 194 | 326 | 3380 |
| Transportation | 25 | 26 | 24 | 18 | 35 | 34 | 58 | 91 | 50 | 48 | 726 |
| Utilities | 6 | 3 | 4 | 2 | 2 | 2 | 5 | 7 | 6 | 8 | 68 |
| **Total** | 1675 | 1963 | 1732 | 1835 | 2045 | 3005 | 3726 | 4716 | 5446 | 7386 | 52 322 |

The frequency of financing rounds in each industry category by year. The sample is obtained from Thompson Financial Data's VentureExpert database which obtains information on private equity investments from over 1000 different companies; 700 of these partner companies are venture funds, while over 250 are buyout and other equity funds. The sample spans over the period 1980–2000 for investments made in 23 208 US firms.

number of investments. The highest number of investments were in the computer software industry (16.4%), followed by Internet (14.0%), communi-cations (12.0%), medical (11.2%), and computer hardware (7.5%).

In Tables 2 and 3, we report the characteristics of the financing and exit over time and across industries.[8] There has been a steady increase over time in the average number of rounds of financing obtained by firms before liquidity events. Given the larger scale of start-up firms in the 1990s, it is likely that they required more financing than anticipated at the outset, marking a difference from the 1980s. This is also noticeable from the trend in the amount of money raised before an IPO or before being acquired.

Not surprisingly, the amount of financing prior to an IPO is higher than that raised before an acquisition. For example, for the Internet company sector, an average firm raised 43 million dollars prior to an IPO versus 17 million prior to being acquired. Interestingly enough, the number of financing rounds before an acquisition is quite similar to that before an IPO, and in some years, tends to be higher.

Also, we see that, as others have documented, there are hot IPO periods.[9] Our data also show that hot financing markets occur concurrently with hot IPO and acquisition markets. The correlation between the number of financing rounds and the number of IPOs is 94%, an extraordinarily high number. While the number of IPOs appears to increase slightly in the 1990s, there is a substantial increase in the number of firms being acquired, reflecting the recent increase in merger and acquisition activity.[10]

The liquidity events for our sample firms are also high in a select few industries. Not surprisingly, the same five industry groups, comprising over 60% of financing rounds, account for the bulk of the IPOs and acquisitions.

## 3 Exit probabilities

### *3.1 Methodology*

Each financing round in our sample is categorized based on the stage of the firm that was being financed. We follow the convention used in the database, thereby dividing the sample into five categories: early-stage companies, expansion-stage, later-stage, buyout/acquisition stage, and others (which includes stages classified as special situations).

Denote the $i$th financing in stage $j$ in year $t$ by $f_{ijt}$, $i = 1,\ldots, N_{jt}$, $j \in J$, $t = 1,\ldots, T$, where $N_{jt}$ is the number of financings in stage $j$ in year $t$ and $T$ is the number of years in the database. Stage $j$ is a choice from set $J$ = {early, expansion, late, buyout, other}. The total number of financing rounds in the database is then equal to:

$$N = \sum_{j}\sum_{t} N_{jt} \qquad (1)$$

For each financing $f_{ijt}$, we record whether the financing resulted in an exit within 3-years of financing, and whether it ultimately resulted in an exit. Exit is marked by the indicator function $1_{ijt}$, which indicates if the financing resulted in an exit, and by the indicator function $1_{ijt'}$ if the exit also occurred within 3-years of financing (note that $1_{ijt'} \leqslant 1_{ijt}$). The probability of exit $p(j, t)$ across all firms in financing stage $j$ in year $t$ is computed as follows:

$$p(j, t) = \frac{\Sigma_i 1_{ijt}}{N_{jt}} \qquad (2)$$

Likewise, the probability of exit in 3-years across all firms in financing stage $j$ in year $t$ is computed as follows:

$$p(j, t<3) = \frac{\Sigma_i 1_{ijt'}}{N_{jt}} \qquad (3)$$

A similar analysis is undertaken for a classification of probabilities by industry and financing stage.

**Table 2** Deal flow and exit categorized by year

| Year | Number of financing rounds | Amount of money raised | IPO | | | | | Acquisitions/buyout | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Average number of rounds | | Amount of money raised | | | Average number of rounds | | Amount of money raised | |
| | | | Frequency | Mean | Median | Mean | Median | Frequency | Mean | Median | Mean | Median |
| 1980 | 558 | 727 | 22 | 2.71 | 2 | 4.24 | 1.70 | | | | | |
| 1981 | 922 | 1578 | 58 | 2.33 | 2 | 2.76 | 1.05 | | | | | |
| 1982 | 1314 | 2021 | 32 | 2.23 | 2 | 5.64 | 3.05 | 1 | 3.00 | 3 | 6.38 | 6.38 |
| 1983 | 1663 | 3770 | 187 | 2.30 | 2 | 5.43 | 2.24 | 1 | 1.00 | | | |
| 1984 | 1814 | 4228 | 86 | 2.57 | 2 | 6.38 | 2.67 | 3 | 3.33 | 5 | 12.285 | 12.285 |
| 1985 | 1751 | 4246 | 81 | 2.85 | 3 | 12.54 | 7.55 | 2 | 2.50 | 4 | 5.751 | 5.751 |
| 1986 | 1965 | 6204 | 222 | 2.78 | 2 | 9.84 | 3.76 | 10 | 3.00 | 2 | 12.21 | 4.45 |
| 1987 | 2156 | 5409 | 172 | 3.49 | 3 | 11.98 | 7.86 | 12 | 2.25 | 2 | 9.52 | 6.45 |
| 1988 | 2233 | 7727 | 76 | 3.91 | 3 | 15.12 | 11.40 | 21 | 2.48 | 1 | 8.050 | 4.000 |
| 1989 | 2370 | 7505 | 85 | 3.79 | 3 | 13.34 | 8.35 | 20 | 3.50 | 4 | 14.654 | 8.496 |
| 1990 | 2047 | 8069 | 97 | 4.08 | 3 | 15.12 | 9.11 | 20 | 2.80 | 2 | 8.62 | 5.22 |
| 1991 | 1675 | 4994 | 233 | 4.15 | 3 | 21.48 | 11.00 | 23 | 2.87 | 2 | 18.74 | 5.36 |
| 1992 | 1963 | 8480 | 287 | 4.14 | 3 | 26.82 | 11.85 | 30 | 2.77 | 2 | 17.437 | 6.129 |
| 1993 | 1732 | 6157 | 322 | 4.22 | 4 | 23.08 | 12.27 | 77 | 3.44 | 3 | 17.430 | 8.611 |
| 1994 | 1835 | 8064 | 230 | 4.10 | 3 | 14.27 | 8.60 | 87 | 4.57 | 3 | 9.87 | 6.77 |
| 1995 | 2045 | 11 029 | 299 | 4.44 | 4 | 19.21 | 9.83 | 119 | 3.55 | 3 | 15.22 | 6.81 |
| 1996 | 3005 | 18 847 | 414 | 4.27 | 4 | 18.59 | 12.27 | 132 | 4.11 | 3 | 15.640 | 7.959 |
| 1997 | 3726 | 24 288 | 248 | 3.80 | 3 | 23.39 | 14.24 | 194 | 3.32 | 2 | 13.334 | 5.216 |
| 1998 | 4716 | 31 041 | 169 | 3.52 | 3 | 35.78 | 19.64 | 214 | 3.43 | 2 | 15.33 | 8.00 |
| 1999 | 5446 | 68 855 | 517 | 3.92 | 4 | 48.75 | 32.61 | 243 | 2.89 | 2 | 17.45 | 11.50 |
| 2000 | 7386 | 11 4300 | 450 | 4.38 | 4 | 60.87 | 43.71 | 263 | 3.00 | 2 | 20.380 | 12.963 |
| **Total** | 52 322 | 347 542 | 4287 | | | | | 1472 | | | | |

Characteristics of the deal flow and exit by the year in which new ventures were financed. The sample is obtained from Thompson Financial Data's VentureExpert database which obtains information on private equity investments from over 1000 different companies; 700 of these partner companies are venture funds, while over 250 are buyout and other equity funds. The sample spans over the period 1980–2000 for investments made in 23 208 US firms. All dollar figures are in millions of dollars.

**Table 3** Deal flow and exit categorized by industry

| Year | Number of financing rounds | Amount of money raised | IPO | | | | | Acquisitions/buyout | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Average number of rounds | | Average amount of money raised | | | Average number of rounds | | Average amount of money raised | |
| | | | Frequency | Mean | Median | Mean | Median | Frequency | Mean | Median | Mean | Median |
| Agriculture/forestry/fisheries | 180 | 480 | 4 | 3.00 | 3 | 32.49 | 32.49 | 2 | 1.00 | 1 | 50.000 | 50.000 |
| Biotechnology | 2730 | 12 783 | 433 | 4.40 | 4 | 27.86 | 17.18 | 65 | 3.62 | 3 | 15.274 | 9.275 |
| Business services | 1153 | 8343 | 64 | 1.95 | 2 | 18.19 | 3.00 | 39 | 2.23 | 1 | 20.81 | 7.81 |
| Communications | 6286 | 55 081 | 519 | 4.26 | 4 | 40.65 | 18.23 | 193 | 3.63 | 3 | 21.72 | 13.39 |
| Computer hardware | 3947 | 13 642 | 350 | 3.77 | 3 | 14.31 | 9.53 | 102 | 4.24 | 3 | 13.529 | 8.549 |
| Computer other | 108 | 318 | 9 | 3.40 | 4 | 20.82 | 4.95 | 4 | 8.25 | 7 | 15.571 | 14.425 |
| Computer software | 8589 | 39 709 | 625 | 4.19 | 3 | 20.32 | 12.00 | 338 | 3.69 | 3 | 11.91 | 8.13 |
| Construction | 292 | 1762 | 15 | 2.25 | 1 | 60.34 | 36.21 | 11 | 1.18 | 1 | 3.48 | 3.55 |
| Consumer related | 4461 | 32 171 | 358 | 2.64 | 2 | 25.82 | 10.58 | 124 | 2.91 | 2 | 26.091 | 10.500 |
| Finance/insurance/real estate | 2096 | 17 034 | 113 | 2.44 | 2 | 30.83 | 7.76 | 87 | 2.63 | 2 | 18.468 | 3.932 |
| Industrial/energy | 3557 | 17 441 | 248 | 3.07 | 2 | 19.33 | 7.35 | 107 | 2.61 | 2 | 10.11 | 5.59 |
| Internet specific | 7334 | 84 615 | 474 | 3.62 | 3 | 42.86 | 31.89 | 115 | 2.97 | 2 | 17.41 | 9.68 |
| Manufacturing | 1295 | 9975 | 63 | 2.16 | 2 | 46.85 | 7.35 | 32 | 2.00 | 1 | 17.201 | 11.189 |
| Medical/health | 5865 | 25 472 | 585 | 3.87 | 3 | 15.53 | 11.12 | 138 | 3.85 | 3 | 11.551 | 5.995 |
| Other | 255 | 1762 | 4 | 2.00 | 2 | 392.16 | 392.16 | | | | | |
| Semiconductor/other | 3380 | 18 812 | 362 | 4.06 | 3 | 19.14 | 9.51 | 90 | 4.40 | 3 | 16.02 | 8.60 |
| Transportation | 726 | 6656 | 55 | 2.06 | 1 | 15.26 | 4.42 | 23 | 2.04 | 2 | 26.715 | 10.612 |
| Utilities | 68 | 1485 | 6 | 2.25 | 2 | 30.00 | 8.33 | 2 | 6.50 | 7 | 15.135 | 15.135 |
| **Total** | 52 322 | 347 542 | 4287 | | | | | 1472 | | | | |

Characteristics of the deal flow and exit by the industry in which new ventures operates. The sample is obtained from Thompson Financial Data's VentureExpert database which obtains information on private equity investments from over 1000 different companies; 700 of these partner companies are venture funds, while over 250 are buyout and other equity funds. The sample spans over the period 1980–2000 for investments made in 23 208 US firms. All dollar figures are in millions of dollars.

Denote the $i$th financing in stage $j$ in industry $k$ by $f_{ijk}$, $i = 1,\ldots, N_{jk}$, $j \in J$, $k = 1,\ldots, K$, where $N_{jk}$ is the number of financings in stage $j$ in industry $k$ and $K$ is the number of industry classifications in the sample. For each financing $f_{ijk}$, we record whether the financing resulted in an exit within 3-years of financing, and whether it ultimately resulted in an exit. Exit is marked by the indicator function $1_{ijk}$, which indicates if the financing resulted in an exit, and by the indicator function $1_{ijk'}$ if the exit also occurred within 3-years of financing (note that $1_{ijk'} \leq 1_{ijk}$).

The probability of exit across all firms in financing stage $j$ in industry $k$ is computed as follows:

$$p(j, k) = \frac{\Sigma_i 1_{ijk}}{N_{jk}} \tag{4}$$

Likewise, the probability of exit in 3-years across all firms in financing stage $j$ in year $t$ is computed as follows:

$$p(j, k, t < 3) = \frac{\Sigma_i 1_{ijk'}}{N_{jk}} \tag{5}$$

### *3.2 Exit probabilities*

Panel A of Table 4 presents the probability of an investment round in our sample having an IPO. Panel B presents similar data for an acquisition/buyout. Combined exit probabilities are depicted in panel C. In addition to the overall probability of exit, we also estimate the probability of a liquidity event within 3-years of financing.

**Table 4** Probability of liquidity events categorized by year of financing

| | Buyout/acq stage | | Early stage | | Expansion stage | | Later stage | | Others | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | **In <3 years (%)** | **Total (%)** | **In <3 years (%)** | **Total (%)** | **In <3 years (%)** | **Total (%)** | **In <3 years (%)** | **Total (%)** | **In <3 years (%)** | **Total (%)** |
| ***A: Probability of an IPO*** | | | | | | | | | | |
| 1980 | 8.20 | 16.39 | 16.02 | 31.55 | 23.45 | 48.28 | 40.00 | 50.00 | 12.93 | 19.83 |
| 1981 | 8.54 | 23.17 | 12.02 | 26.85 | 20.66 | 32.84 | 29.51 | 42.62 | 4.27 | 9.40 |
| 1982 | 3.96 | 16.83 | 8.30 | 25.96 | 15.93 | 27.14 | 27.34 | 35.94 | 3.62 | 9.06 |
| 1983 | 8.45 | 20.42 | 6.05 | 19.97 | 15.09 | 27.85 | 26.95 | 42.55 | 8.55 | 13.82 |
| 1984 | 12.50 | 18.18 | 4.52 | 16.47 | 10.94 | 22.39 | 17.19 | 29.17 | 6.48 | 12.04 |
| 1985 | 9.57 | 14.35 | 4.09 | 16.21 | 10.54 | 23.58 | 22.73 | 34.71 | 7.14 | 19.05 |
| 1986 | 6.09 | 14.78 | 3.91 | 19.16 | 7.29 | 22.57 | 25.93 | 35.56 | 18.18 | 30.30 |
| 1987 | 2.51 | 10.97 | 2.85 | 20.97 | 5.91 | 21.71 | 15.11 | 25.98 | 13.04 | 17.39 |
| 1988 | 2.25 | 10.30 | 4.44 | 26.61 | 6.75 | 22.13 | 9.83 | 25.64 | 16.00 | 28.00 |
| 1989 | 4.80 | 10.40 | 8.07 | 27.20 | 11.56 | 25.81 | 17.52 | 29.93 | 4.76 | 33.33 |
| 1990 | 7.29 | 13.07 | 9.89 | 27.36 | 17.05 | 26.93 | 17.59 | 28.97 | 35.71 | 42.86 |
| 1991 | 15.38 | 22.38 | 11.96 | 32.83 | 16.48 | 27.36 | 20.05 | 27.27 | 27.78 | 50.00 |
| 1992 | 14.29 | 23.50 | 11.85 | 28.49 | 15.79 | 27.05 | 16.13 | 26.76 | 25.00 | 25.00 |
| 1993 | 11.32 | 17.61 | 15.81 | 28.85 | 17.34 | 25.57 | 19.46 | 22.18 | 10.00 | 10.00 |
| 1994 | 14.66 | 16.23 | 16.28 | 27.24 | 21.12 | 26.52 | 18.10 | 21.09 | 17.86 | 17.86 |
| 1995 | 12.20 | 16.93 | 12.58 | 22.22 | 23.26 | 28.33 | 22.29 | 25.00 | 16.13 | 16.13 |
| 1996 | 13.23 | 14.76 | 10.22 | 21.86 | 16.81 | 23.17 | 19.88 | 22.26 | 0.00 | 2.56 |
| 1997 | 9.84 | 10.88 | 10.19 | 12.38 | 15.92 | 18.67 | 15.73 | 16.59 | 5.17 | 5.17 |
| 1998 | 8.05 | 8.05 | 9.35 | 9.35 | 16.23 | 16.23 | 16.28 | 16.28 | 1.27 | 1.27 |
| 1999 | 5.70 | 5.70 | 1.78 | 1.78 | 10.86 | 10.86 | 27.03 | 27.03 | 2.17 | 2.17 |
| 2000 | 1.22 | 1.22 | 0.18 | 0.18 | 1.92 | 1.92 | 4.73 | 4.73 | 1.57 | 1.57 |
| ***Average from 1980 to 1997*** | | | | | | | | | | |
| | **8.24** | **14.36** | **8.76** | **22.62** | **14.37** | **24.79** | **18.97** | **25.67** | **7.84** | **13.63** |

**Table 4** (*Continued*)

| | Buyout/acq stage | | Early stage | | Expansion stage | | Later stage | | Others | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | In <3 years (%) | Total (%) | In <3 years (%) | Total (%) | In <3 years (%) | Total (%) | In <3 years (%) | Total (%) | In <3 years (%) | Total (%) |
| *B: Probability of a buyout/acquisition* | | | | | | | | | | |
| 1980 | 0.00 | 8.20 | 0.00 | 1.94 | 0.00 | 1.38 | 0.00 | 6.67 | 0.00 | 1.72 |
| 1981 | 0.00 | 0.00 | 0.51 | 4.09 | 0.00 | 2.21 | 0.00 | 4.92 | 0.00 | 3.42 |
| 1982 | 0.99 | 2.97 | 0.21 | 3.62 | 0.29 | 3.24 | 0.78 | 2.34 | 0.00 | 0.36 |
| 1983 | 0.00 | 1.41 | 0.42 | 4.22 | 0.00 | 2.51 | 1.42 | 7.09 | 0.66 | 1.97 |
| 1984 | 0.00 | 1.14 | 0.80 | 6.91 | 1.03 | 5.81 | 2.60 | 8.33 | 0.00 | 6.48 |
| 1985 | 0.00 | 1.91 | 0.76 | 6.97 | 1.00 | 7.02 | 0.83 | 5.79 | 0.00 | 4.76 |
| 1986 | 1.74 | 6.96 | 0.81 | 6.34 | 1.56 | 9.03 | 1.85 | 10.37 | 3.03 | 6.06 |
| 1987 | 0.31 | 5.96 | 1.36 | 7.07 | 1.48 | 7.24 | 1.81 | 6.04 | 8.70 | 8.70 |
| 1988 | 0.94 | 6.55 | 0.40 | 10.48 | 2.01 | 10.49 | 1.71 | 9.83 | 0.00 | 4.00 |
| 1989 | 0.96 | 7.20 | 0.99 | 10.20 | 2.28 | 11.96 | 1.46 | 12.77 | 0.00 | 9.52 |
| 1990 | 1.01 | 10.80 | 2.01 | 14.37 | 1.72 | 16.33 | 6.90 | 27.24 | 7.14 | 14.29 |
| 1991 | 5.59 | 16.08 | 5.87 | 14.35 | 4.96 | 18.24 | 12.35 | 27.74 | 5.56 | 16.67 |
| 1992 | 6.91 | 18.43 | 6.69 | 16.25 | 8.04 | 21.78 | 11.57 | 24.67 | 25.00 | 25.00 |
| 1993 | 10.69 | 25.79 | 8.12 | 19.02 | 10.33 | 19.09 | 14.98 | 27.82 | 20.00 | 35.00 |
| 1994 | 14.14 | 19.90 | 10.47 | 19.10 | 10.11 | 17.30 | 13.71 | 19.51 | 7.14 | 7.14 |
| 1995 | 9.06 | 13.78 | 7.63 | 15.93 | 11.26 | 15.95 | 22.08 | 26.67 | 6.45 | 6.45 |
| 1996 | 9.67 | 13.74 | 11.03 | 16.70 | 11.64 | 15.49 | 20.18 | 21.96 | 2.56 | 3.42 |
| 1997 | 8.55 | 9.59 | 10.87 | 13.23 | 12.24 | 13.80 | 13.54 | 13.54 | 6.90 | 6.90 |
| 1998 | 5.52 | 5.52 | 8.29 | 8.29 | 9.04 | 9.04 | 6.35 | 6.35 | 0.85 | 0.85 |
| 1999 | 2.68 | 2.68 | 4.11 | 4.11 | 6.07 | 6.07 | 1.62 | 1.62 | 2.17 | 2.17 |
| 2000 | 0.41 | 0.41 | 0.22 | 0.22 | 1.14 | 1.14 | 0.00 | 0.00 | 0.00 | 0.00 |
| *Average from 1980 to 1997* | | | | | | | | | | |
| | 3.89 | 9.50 | 4.36 | 11.08 | 5.35 | 12.25 | 10.81 | 18.10 | 1.98 | 4.38 |
| *C: Probability of an IPO or acquisition* | | | | | | | | | | |
| 1980 | 8.20 | 24.59 | 16.02 | 33.50 | 23.45 | 49.66 | 40.00 | 56.67 | 12.93 | 21.55 |
| 1981 | 8.54 | 23.17 | 12.53 | 30.95 | 20.66 | 35.06 | 29.51 | 47.54 | 4.27 | 12.82 |
| 1982 | 4.95 | 19.80 | 8.51 | 29.57 | 16.22 | 30.38 | 28.13 | 38.28 | 3.62 | 9.42 |
| 1983 | 8.45 | 21.83 | 6.47 | 24.19 | 15.09 | 30.37 | 28.37 | 49.65 | 9.21 | 15.79 |
| 1984 | 12.50 | 19.32 | 5.31 | 23.37 | 11.97 | 28.21 | 19.79 | 37.50 | 6.48 | 18.52 |
| 1985 | 9.57 | 16.27 | 4.85 | 23.18 | 11.54 | 30.60 | 23.55 | 40.50 | 7.14 | 23.81 |
| 1986 | 7.83 | 21.74 | 4.72 | 25.51 | 8.85 | 31.60 | 27.78 | 45.93 | 21.21 | 36.36 |
| 1987 | 2.82 | 16.93 | 4.22 | 28.04 | 7.39 | 28.95 | 16.92 | 32.02 | 21.74 | 26.09 |
| 1988 | 3.18 | 16.85 | 4.84 | 37.10 | 8.76 | 32.61 | 11.54 | 35.47 | 16.00 | 32.00 |
| 1989 | 5.76 | 17.60 | 9.07 | 37.39 | 13.84 | 37.77 | 18.98 | 42.70 | 4.76 | 42.86 |
| 1990 | 8.29 | 23.87 | 11.90 | 41.73 | 18.77 | 43.27 | 24.48 | 56.21 | 42.86 | 57.14 |
| 1991 | 20.98 | 38.46 | 17.83 | 47.17 | 21.44 | 45.60 | 32.40 | 55.01 | 33.33 | 66.67 |
| 1992 | 21.20 | 41.94 | 18.55 | 44.74 | 23.83 | 48.83 | 27.70 | 51.42 | 50.00 | 50.00 |
| 1993 | 22.01 | 43.40 | 23.93 | 47.86 | 27.67 | 44.66 | 34.44 | 50.00 | 30.00 | 45.00 |
| 1994 | 28.80 | 36.13 | 26.74 | 46.35 | 31.24 | 43.82 | 31.81 | 40.60 | 25.00 | 25.00 |
| 1995 | 21.26 | 30.71 | 20.21 | 38.15 | 34.52 | 44.28 | 44.38 | 51.67 | 22.58 | 22.58 |
| 1996 | 22.90 | 28.50 | 21.26 | 38.56 | 28.45 | 38.66 | 40.06 | 44.21 | 2.56 | 5.98 |
| 1997 | 18.39 | 20.47 | 21.06 | 25.61 | 28.16 | 32.47 | 29.27 | 30.12 | 12.07 | 12.07 |
| 1998 | 13.56 | 13.56 | 17.64 | 17.64 | 25.27 | 25.27 | 22.63 | 22.63 | 2.12 | 2.12 |

**Table 4** (*Continued*)

| | Buyout/acq stage | | Early stage | | Expansion stage | | Later stage | | Others | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | In <3 years (%) | Total (%) | In <3 years (%) | Total (%) | In <3 years (%) | Total (%) | In <3 years (%) | Total (%) | In <3 years (%) | Total (%) |
| 1999 | 8.39 | 8.39 | 5.89 | 5.89 | 16.93 | 16.93 | 28.65 | 28.65 | 4.35 | 4.35 |
| 2000 | 1.63 | 1.63 | 0.40 | 0.40 | 3.06 | 3.06 | 4.73 | 4.73 | 1.57 | 1.57 |
| *Average from 1980 to 1997* | | | | | | | | | | |
| | 12.12 | 23.86 | 13.12 | 33.69 | 19.72 | 37.03 | 29.78 | 43.76 | 9.83 | 18.00 |

The probabilities of exit by year of financing. Panel A presents the probability of an IPO, panel B presents the probability of an acquisition/buyout and panel C presents probability of an IPO or an acquisition. Total exit probabilities are depicted in panel C. In addition to the total probability of exit, we also present the probability when exit occurs within 3 years of financing. The exit probability is presented by financing stage, i.e. early, expansion, later, buyout stage, or others. The probability of an exit by IPO is computed to be the ratio of the number of firms in any financing year that led to an IPO divided by the number of financing rounds in the same year. The probability of an exit by acquisition is computed to be the ratio of the number of firms in any financing year that led to a buyout divided by the number of financing rounds in the same year. The average across all years is the number of exits divided by the total number of financings. Notice that we present averages only for the period 1980–1997. This is due to the fact that the data on financing from 1998 to 2000 is too recent to determine whether or not exit has definitively occurred, or failed to occur.

We find that the probability of exit via an IPO increases as we progress from early stage to the expansion stage, and into the later stage. The probability of a firm financed in the buyout stage to have an IPO is as expected quite low, as firms in that stage are more likely to be sold.

The probability of exit falls off dramatically in the last 3-years in the sample (1998–2000). This is partly because for many of these recently financed firms, enough time has not passed for them to have had a successful exit. It is for this reason that we report averages of exit probabilities only for the sub-period 1980–1997.

We find that for our sample the probability of an exit via an IPO is roughly 20–25%, and is fairly constant for firms financed in an early stage, expansion stage, or later stage. Similarly, we find the probability of exit via an acquisition is approximately 10–20%. The probability of an acquisition is much higher for the firms financed in later stages. Therefore, the total probability of exit lies in the range of 30–45%. In other recent work covering a smaller period, Gompers and Lerner (1999b) report that, for the period 1983–1994, about 31% of the firms in the VentureOne database completed an IPO and another 29% were acquired. They also found that around 19% of the firms were liquidated, and 21% were still privately held.[11] They conducted a logit regression to establish the determinants of the exit, and found that the development stage of the firm (i.e. development, beta, shipping, profitable, or restart stage) is a significant determining factor. The variation across stages is quite marked in our data as well.

Table 4, Panel B reports the probability of exit via an acquisition. The probabilities increase as we move from early- to late-stage financings. However, it is interesting that the probability of an acquisition is actually slightly higher for early-stage companies than it is for firms classified as buyout targets. This may be because many early-stage firms that were unable to make it to the IPO stage settled instead for a buyout. Panel C reports the total probabilities of a liquidity event, either from an IPO or an acquisition. As many as 44% of the

companies in late-stage financings experienced a liquidity event, reflecting the efficacy of the market for private equity.

Table 5 presents exit probability data across different industry segments. Clearly, some industries have had a higher proportion of successful exits. Specifically, the "new economy" sectors evidenced much higher success rates. Also, across almost all industry groups we find that the probability of an IPO increases with the financing stage.

**Table 5** Probability of liquidity events categorized by industry

| | Buyout/acquisition | | Early stage | | Expansion | | Later | | Others | |
|---|---|---|---|---|---|---|---|---|---|---|
| Industry sector | In <3 years (%) | Total (%) | In <3 years (%) | Total (%) | In <3 years (%) | Total (%) | In <3 years (%) | Total (%) | In <3 years (%) | Total (%) |
| ***A: Probability of an IPO*** | | | | | | | | | | |
| Agriculture/forestry/ fisheries | 3.13 | 3.13 | 0.00 | 2.22 | 3.45 | 6.90 | 0.00 | 0.00 | 0.00 | 0.00 |
| Biotechnology | 7.69 | 23.08 | 17.06 | 38.31 | 30.21 | 42.57 | 31.86 | 36.47 | 22.58 | 29.03 |
| Business services | 4.06 | 5.90 | 4.23 | 6.19 | 7.16 | 11.57 | 6.90 | 7.59 | 2.99 | 2.99 |
| Communications | 7.46 | 11.33 | 7.33 | 18.71 | 12.78 | 20.27 | 20.29 | 25.67 | 12.21 | 15.12 |
| Computer hardware | 12.12 | 16.67 | 5.17 | 15.36 | 12.33 | 19.87 | 18.42 | 24.34 | 16.26 | 27.64 |
| Computer other | 33.33 | 33.33 | 2.94 | 14.71 | 9.76 | 26.83 | 0.00 | 0.00 | 0.00 | 0.00 |
| Computer software | 17.75 | 28.99 | 3.87 | 11.52 | 10.23 | 17.15 | 17.78 | 21.83 | 11.54 | 16.92 |
| Construction | 1.72 | 5.17 | 0.00 | 7.50 | 1.27 | 3.80 | 7.89 | 21.05 | 0.00 | 10.53 |
| Consumer related | 6.49 | 11.91 | 5.99 | 10.73 | 7.38 | 13.11 | 11.40 | 14.14 | 4.30 | 5.91 |
| Finance/insurance/ real estate | 11.05 | 16.45 | 4.35 | 9.78 | 6.70 | 9.50 | 8.58 | 9.98 | 0.90 | 0.90 |
| Industrial/energy | 5.17 | 8.98 | 5.25 | 15.41 | 5.40 | 11.96 | 11.72 | 16.85 | 2.86 | 7.62 |
| Internet specific | 16.00 | 20.80 | 6.17 | 8.54 | 12.01 | 13.03 | 23.24 | 24.30 | 3.23 | 4.84 |
| Manufacturing | 2.54 | 6.43 | 3.69 | 6.45 | 4.00 | 6.18 | 8.03 | 12.41 | 4.00 | 5.33 |
| Medical/health | 14.91 | 22.00 | 9.19 | 21.27 | 15.50 | 22.71 | 18.13 | 22.52 | 4.42 | 9.73 |
| Other | 6.00 | 8.00 | 0.00 | 0.00 | 0.00 | 0.00 | 4.76 | 4.76 | 0.00 | 0.00 |
| Semiconductor/ other | 11.40 | 22.37 | 4.98 | 19.28 | 14.07 | 26.78 | 18.64 | 31.28 | 9.57 | 24.35 |
| Transportation | 5.88 | 8.82 | 5.51 | 10.24 | 5.78 | 13.29 | 7.55 | 17.92 | 2.08 | 6.25 |
| Utilities | 11.11 | 11.11 | 0.00 | 0.00 | 12.50 | 12.50 | 20.00 | 60.00 | 0.00 | 0.00 |
| ***B: Probability of a buyout/acquisition*** | | | | | | | | | | |
| Agriculture/forestry/ fisheries | 0.00 | 6.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Biotechnology | 15.38 | 23.08 | 3.46 | 8.38 | 3.75 | 6.99 | 7.01 | 11.02 | 0.00 | 0.00 |
| Business services | 6.27 | 10.70 | 4.56 | 7.49 | 4.13 | 5.51 | 4.14 | 8.28 | 0.00 | 0.00 |
| Communications | 4.97 | 9.25 | 5.62 | 9.81 | 5.56 | 11.08 | 8.53 | 14.18 | 1.74 | 4.65 |
| Computer hardware | 1.52 | 7.58 | 3.28 | 9.99 | 5.27 | 10.67 | 6.84 | 12.50 | 2.44 | 6.50 |
| Computer other | 0.00 | 0.00 | 2.94 | 23.53 | 9.76 | 29.27 | 24.00 | 48.00 | 0.00 | 0.00 |
| Computer software | 8.33 | 20.65 | 6.66 | 13.53 | 7.96 | 12.81 | 13.28 | 17.84 | 6.92 | 9.23 |
| Construction | 2.59 | 4.31 | 0.00 | 2.50 | 5.06 | 8.86 | 0.00 | 0.00 | 0.00 | 0.00 |
| Consumer related | 2.30 | 6.57 | 2.79 | 5.99 | 3.22 | 7.95 | 6.20 | 12.99 | 0.00 | 1.61 |
| Finance/insurance/ real estate | 3.60 | 10.28 | 1.36 | 3.80 | 7.56 | 12.53 | 15.78 | 26.22 | 0.00 | 0.22 |
| Industrial/energy | 3.20 | 6.27 | 1.83 | 7.42 | 2.07 | 8.72 | 4.95 | 9.34 | 0.48 | 2.38 |

**Table 5** (*Continued*)

| Industry sector | Buyout/acquisition | | Early stage | | Expansion | | Later | | Others | |
|---|---|---|---|---|---|---|---|---|---|---|
| | In <3 years (%) | Total (%) | In <3 years (%) | Total (%) | In <3 years (%) | Total (%) | In <3 years (%) | Total (%) | In <3 years (%) | Total (%) |
| Internet specific | 0.00 | 0.80 | 3.32 | 4.27 | 3.40 | 4.31 | 5.01 | 6.08 | 8.06 | 8.06 |
| Manufacturing | 1.86 | 5.08 | 0.92 | 3.69 | 1.82 | 3.27 | 0.73 | 6.57 | 0.00 | 1.33 |
| Medical/health | 8.31 | 12.47 | 3.32 | 7.89 | 4.40 | 8.18 | 6.73 | 10.37 | 7.08 | 7.96 |
| Other | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Semiconductor/ other | 2.19 | 9.65 | 3.84 | 9.48 | 6.02 | 12.37 | 6.95 | 15.96 | 0.87 | 6.09 |
| Transportation | 2.94 | 6.25 | 0.79 | 1.57 | 4.62 | 9.25 | 4.72 | 6.60 | 0.00 | 0.00 |
| Utilities | 14.81 | 44.44 | 0.00 | 0.00 | 4.17 | 4.17 | 0.00 | 0.00 | 0.00 | 0.00 |
| ***C: Probability of an IPO or acquisition*** | | | | | | | | | | |
| Agriculture/forestry/ fisheries | 3.13 | 9.38 | 0.00 | 2.22 | 3.45 | 6.90 | 0.00 | 0.00 | 0.00 | 0.00 |
| Biotechnology | 23.08 | 46.15 | 20.51 | 46.69 | 33.96 | 49.56 | 38.88 | 47.49 | 22.58 | 29.03 |
| Business services | 10.33 | 16.61 | 8.79 | 13.68 | 11.29 | 17.08 | 11.03 | 15.86 | 2.99 | 2.99 |
| Communications | 12.43 | 20.58 | 12.95 | 28.52 | 18.34 | 31.34 | 28.82 | 39.86 | 13.95 | 19.77 |
| Computer hardware | 13.64 | 24.24 | 8.45 | 25.35 | 17.60 | 30.53 | 25.26 | 36.84 | 18.70 | 34.15 |
| Computer other | 33.33 | 33.33 | 5.88 | 38.24 | 19.51 | 56.10 | 24.00 | 48.00 | 0.00 | 0.00 |
| Computer software | 26.09 | 49.64 | 10.53 | 25.05 | 18.19 | 29.97 | 31.06 | 39.67 | 18.46 | 26.15 |
| Construction | 4.31 | 9.48 | 0.00 | 10.00 | 6.33 | 12.66 | 7.89 | 21.05 | 0.00 | 10.53 |
| Consumer related | 8.79 | 18.49 | 8.77 | 16.72 | 10.60 | 21.06 | 17.60 | 27.13 | 4.30 | 7.53 |
| Finance/insurance/ real sstate | 14.65 | 26.74 | 5.71 | 13.59 | 14.25 | 22.03 | 24.36 | 36.19 | 0.90 | 1.12 |
| Industrial/energy | 8.36 | 15.25 | 7.08 | 22.83 | 7.46 | 20.68 | 16.67 | 26.19 | 3.33 | 10.00 |
| Internet specific | 16.00 | 21.60 | 9.49 | 12.82 | 15.41 | 17.34 | 28.25 | 30.38 | 11.29 | 12.90 |
| Manufacturing | 4.40 | 11.51 | 4.61 | 10.14 | 5.82 | 9.45 | 8.76 | 18.98 | 4.00 | 6.67 |
| Medical/health | 23.23 | 34.47 | 12.51 | 29.16 | 19.90 | 30.90 | 24.86 | 32.90 | 11.50 | 17.70 |
| Other | 6.00 | 8.00 | 0.00 | 0.00 | 0.00 | 0.00 | 4.76 | 4.76 | 0.00 | 0.00 |
| Semiconductor/other | 13.60 | 32.02 | 8.82 | 28.76 | 20.08 | 39.15 | 25.59 | 47.24 | 10.43 | 30.43 |
| Transportation | 8.82 | 15.07 | 6.30 | 11.81 | 10.40 | 22.54 | 12.26 | 24.53 | 2.08 | 6.25 |
| Utilities | 25.93 | 55.56 | 0.00 | 0.00 | 16.67 | 16.67 | 20.00 | 60.00 | 0.00 | 0.00 |

The probabilities of exit by industry. Panel A presents the probability of an IPO, panel B presents the probability of an acquisition/buyout and panel C presents probability of an IPO or an acquisition. Total exit probabilities are depicted in panel C. In addition to the total probability of exit, we also present the probability when exit occurs within 3 years of financing. The exit probability is presented by financing stage, i.e. early, expansion, later, buyout stage, or others. The probability of an exit by IPO is computed to be the ratio of the number of firms in any financing year that led to an IPO divided by the number of financing rounds in the same year. The probability of an exit by acquisition is computed to be the ratio of the number of firms in any financing year that led to a buyout divided by the number of financing rounds in the same year. The average across all years is the number of exits divided by the total number of financings.

In results not reported, we also estimated exit probabilities stratified by the number of the financing round.[12] It is natural to expect that the probability of exit will increase as the number of the round also increases. Renewed financing is usually conditional on prior success, and should presage an increase in the probability of a successful exit. Specifically, the probability of exit increases rapidly for the first two financing rounds, and increases very slowly thereafter. This suggests that failure is a greater danger in early rounds, as would be expected. It also implies that later rounds may be

less useful in increasing the probability of success. Again, we see that the probability of exit increases with the stage of financing.

In addition, we estimated exit probabilities stratified by the amount of financing in the round. We first sorted our sample firms into deciles based on the amount of financing. We find that the probability of exit increases with the amount of financing, though this seems much more marked for IPO exits, than for exits via acquisition.

Finally, we examined exit probabilities stratified by the amount of the post-money valuation. For exits via an IPO, there is a marked increase in the likelihood of an exit as the valuation increases. It is interesting that exactly the opposite effect occurs for exits via acquisitions, that is, the probability of exit declines as the post-money valuation increases. The conclusion that we draw from these opposite effects is that firms with high post-money valuations are more likely to exit via an IPO than by acquisition. (See Figs 1 and 2).

## 4 Exit multiples

### *4.1 Methodology*

The private equity valuation discount is reflected in the extra rate of return required on the private firm over the return earned by investing in a public firm. Investing in private equity is akin to buying a highly risky discount security, where the maturity date is unknown. Substantial payoff risk is also borne. Given these features, venture capitalists tend to think of payoffs more in terms of multiples of their initial investment, rather than in terms of steady, annual rates of return. Hence, part of the value creation comes from the VCs' ability to

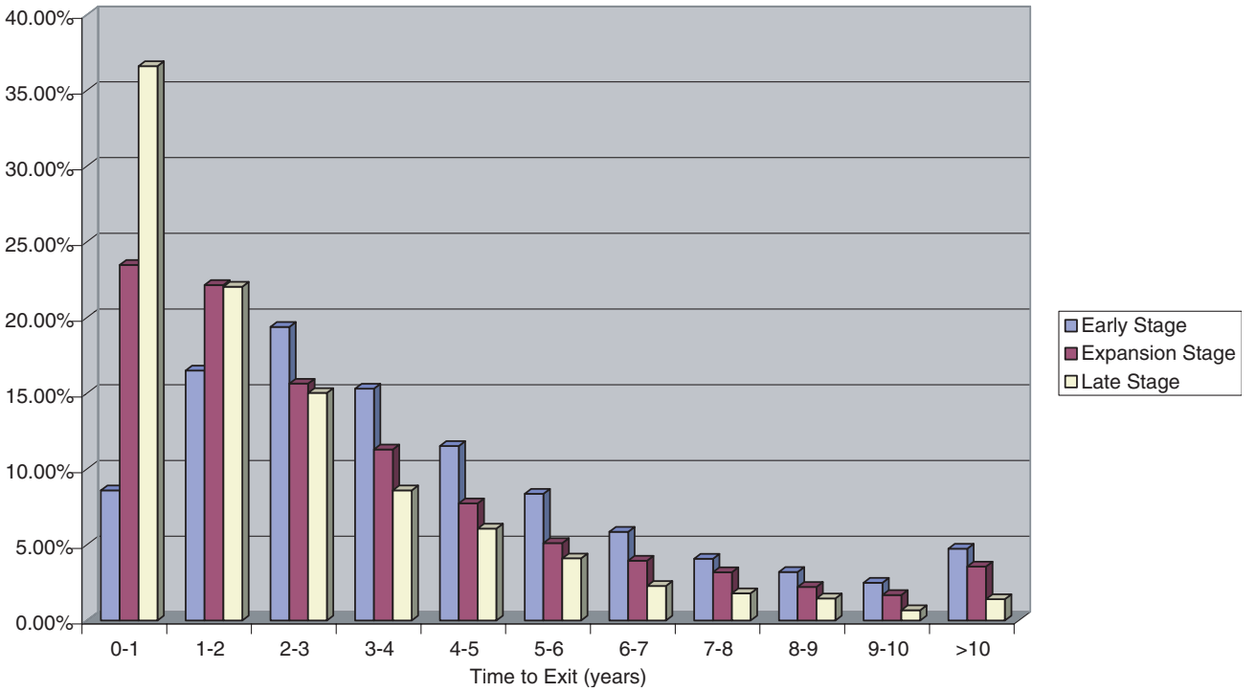


**Figure 1** Frequency of time to exit for the firms in our sample having an IPO or an accquisition/buyout. The sample is obtained from Thompson Financial Data's VentureExpert database which obtains information on private equity investments from over 1000 different companies; 700 of these partner companies are venture funds, while over 250 are buyout and other equity funds. The sample spans over the period 1980–2000 for investments made in 23 208 US firms.

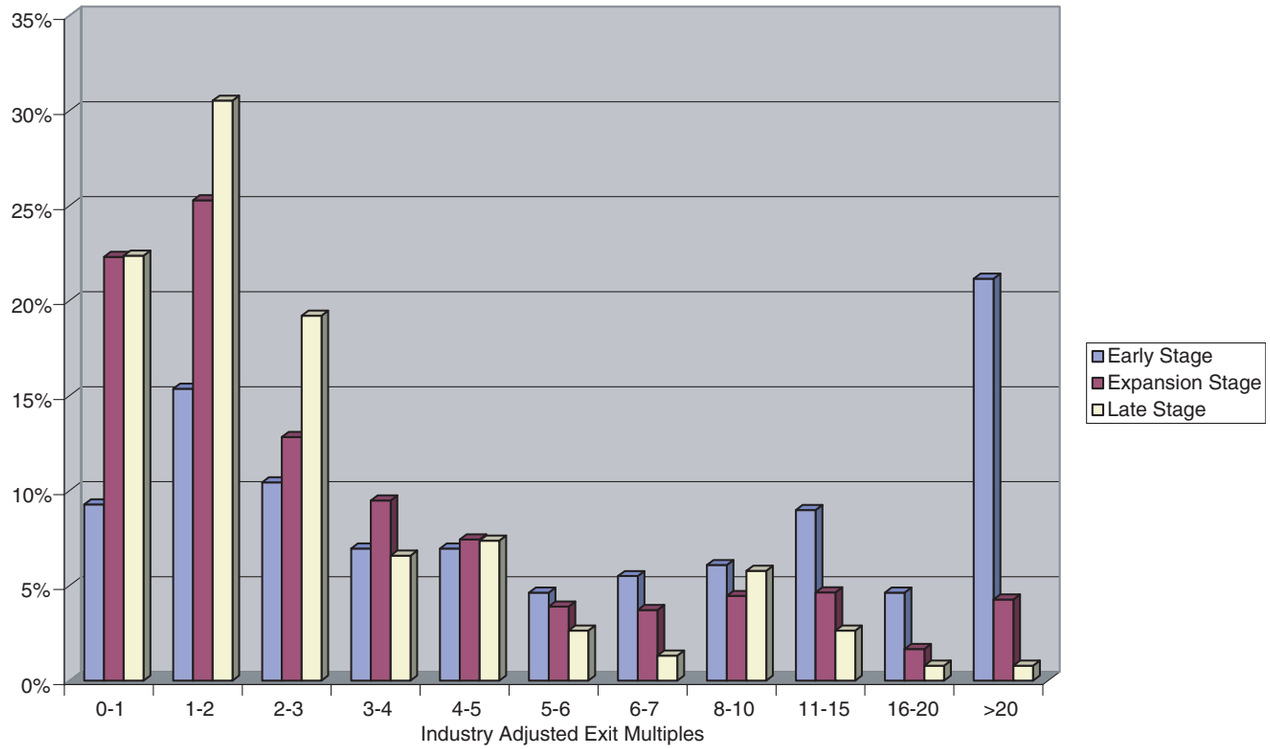


**Figure 2** Frequency of industry adjusted exit multiples for the firms in our sample having an IPO or an accquisition/buyout. The sample is obtained from Thompson Financial Data's VentureExpert database which obtains information on private equity investments from over 1000 different companies; 700 of these partner companies are venture funds, while over 250 are buyout and other equity funds. The sample spans over the period 1980–2000 for investments made in 23 208 US firms.

negotiate an attractively discounted price. Our goal in this paper is to cast light on the extent of this discount.

For each firm, which has an IPO or is acquired, exit multiples are computed as follows, denoted $X_{ijt}$ or $X_{ijk}$ (generically $X_{ij}$) depending on whether the data are segmented by year of financing or by industry category, respectively. The following variables are defined:

$$X_{\text{raw}} = \frac{\text{Exit valuation (at IPO or ACQ)}}{\text{Financing valuation}}$$

$$X_{\text{ind}} = \frac{\text{Industry index (at IPO or ACQ)}}{\text{Industry index at financing}}$$

$$X_{ij} = \frac{X_{\text{raw}}}{X_{\text{ind}}}$$

Here, $X_{ij}$ is the return multiple expressed over the benchmark return. Both the valuation at exit and financing are post-money. This ratio is commonly used by venture capitalists as it provides a direct way of assessing the payback from the private equity investment. Notice that the excess return (denoted $R_{ij}$) is equal to $(X_{\text{raw}} - X_{\text{ind}})$. Thus, on an initial investment of 100, an IPO at a value of 500 would imply that $X_{\text{raw}} = 5$, and if the industry index went from 100 to 150, then the excess return is $R_{ij} = 350\%$. The excess multiple would be 5/1.5.

It is important to ensure that the raw multiple has been adjusted for dilution effects during the financing path, as the stake of the original capital providers gets diluted in subsequent financing rounds. This is best explained with an example. Let the original investment be 100. The second round of financing is also for an amount of 100, with a

post-money valuation of 500. This implies that the original investors have parted with 20% of the firm (=100/500). Hence, the first-round retention ratio is 80%. Assume then that the firm has an IPO value of 1000, and raises extra capital in the IPO of 300. The dilution at the IPO is 30% (=300/1000), or a retention ratio of 70%. The cumulative retention ratio is, therefore, 56% (= 0.8 × 0.7). The multiple on the initial investment before dilution effects is 10 (=1000/100). The multiple on the initial investment after dilution is correctly accounted for is equal to 5.6, that is, the multiple of 10 multiplied by the cumulative retention ratio. Using similar logic, the second-round investment multiple would be 1.4, that is, the multiple of 2 (=1000/500) diluted by the cumulative retention ratio of 70%.

Our multiple measure is not adjusted for the time between financing and exit. The annualized values are computed as follows:

$$X_{\text{annual}} = [X_{\text{raw}}]^{1/t} \tag{6}$$

$$t = \frac{\text{days}}{365} \tag{7}$$

$$R_{\text{annual}} = X_{\text{annual}} - 1 \tag{8}$$

Therefore, if $X_{\text{raw}} = 5$, and the number of days from financing to IPO is 900, then $X_{\text{annual}} = 5^{(365/900)} = 5^{0.40556} = 1.92075$. The return is $R_{\text{annual}} = 0.92075$, or 92% per annum.

This approach offers a method for normalization and comparison of gains, since each firm takes a different amount of time to exit. However, the measure does have some limitations. When the number of days is very small, the measure tends to inflate annualized multiples excessively. This often occurs when a financing has been undertaken just prior to an IPO. In the preceding example, if days = 10, then $X_{\text{annual}} = 3.25 \times 1025$. This creates outliers, which distort further empirical analysis.

A pragmatic solution to this problem is to round up all fractions of a year to a whole year. The new expression for annualized multiples is then stated by

$$X_{\text{annual}} = [X_{\text{raw}}]^{1/t} \tag{9}$$

$$t = CEIL\left[\frac{\text{days}}{365}\right] \tag{10}$$

where the function $CEIL(x)$ stands for the integer immediately greater than $x$. Hence, the same analysis in the steps above is now implementable using annualized multiples.

### *4.2 Exit multiples*

Valuations at funding stage are usually affected by the state of the stock markets and supply of venture capital. Lerner (1997) finds that financing pressure significantly affects valuations. More money chasing deals will result in higher pre-money valuations. In a recent paper, Gompers and Lerner (2000b) construct a hedonic price index for venture valuations. This index is shown to be very sensitive to venture fund inflows. They estimate that a doubling of venture flows results in a 7–21% increase in valuation levels.[13]

Table 6 presents valuation multiples by year of financing. We are able to assess whether there is time series variation in valuation multiples by year of financing, leading to an alternative view of "hot" financing markets, that is, whether the year of financing determines exit multiples. In hot financing markets, money chases deals (Gompers and Lerner, 2000a), and may result in higher post-money valuations, leading to lower realized multiples.

Panel A of Table 6 presents raw exit multiples for investments that led to an IPO for the period 1984–2000.[14] As is expected, the realized multiples are highest for early-stage companies (21.01), lower for expansion-stage firms (7.90), and are lowest for later-stage companies (4.01). This pattern is

**Table 6** Valuation multiples categorized by year of financing

| | Buyout/acqusition | | | Early stage | | | Expansion stage | | | Later stage | | | Others | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Raw | Annualized | Frequency | Raw | Annualized | Frequency | Raw | Annualized | Frequency | Raw | Annualized | Frequency | Raw | Annualized | Frequency |
| *A: Raw multiples for firms having an IPO* | | | | | | | | | | | | | | | |
| 1984 | | | | | | | 4.18 | 1.15 | 1 | | | | | | |
| 1985 | | | | | | | | | | 3.95 | 1.13 | 1 | | | |
| 1986 | | | | 2.80 | 1.16 | 2 | | | | | | | | | |
| 1987 | | | | 2.50 | 1.02 | 3 | 1.85 | 1.11 | 1 | | | | | | |
| 1988 | | | | 3.45 | 1.35 | 3 | | | | 9.36 | 1.25 | 2 | | | |
| 1989 | | | | 3.28 | 1.38 | 3 | 3.15 | 1.24 | 3 | 0.74 | 0.93 | 1 | | | |
| 1990 | | | | 2.31 | 1.22 | 3 | | | | 1.43 | 1.13 | 5 | | | |
| 1991 | 2.40 | 1.55 | 1 | 36.94 | 1.82 | 5 | 4.38 | 1.22 | 5 | 1.75 | 1.27 | 2 | | | |
| 1992 | 1.33 | 1.33 | 2 | 6.35 | 1.59 | 7 | 11.92 | 1.33 | 11 | 3.03 | 1.49 | 11 | | | |
| 1993 | | | | 8.54 | 1.43 | 10 | 4.72 | 1.58 | 16 | 2.65 | 2.22 | 7 | | | |
| 1994 | 30.97 | 2.36 | 1 | 8.33 | 1.61 | 19 | 5.39 | 1.52 | 15 | 2.81 | 1.58 | 11 | 5.82 | 2.41 | 1 |
| 1995 | 2.20 | 1.48 | 1 | 18.93 | 2.07 | 27 | 8.17 | 2.56 | 27 | 6.40 | 2.97 | 8 | | | |
| 1996 | 3.45 | 1.99 | 5 | 24.18 | 2.21 | 88 | 8.63 | 1.63 | 48 | 3.62 | 1.68 | 32 | | | |
| 1997 | 14.62 | 2.33 | 13 | 27.35 | 3.04 | 66 | 8.31 | 2.22 | 108 | 4.74 | 1.94 | 50 | | | |
| 1998 | 5.55 | 4.18 | 6 | 29.67 | 5.88 | 68 | 6.11 | 3.15 | 110 | 4.90 | 3.45 | 73 | 3.05 | 1.59 | 3 |
| 1999 | 6.69 | 5.28 | 5 | 10.46 | 4.98 | 25 | 5.61 | 3.93 | 129 | 3.35 | 3.21 | 136 | | | |
| 2000 | | | | 0.94 | 0.94 | 3 | 1.41 | 1.41 | 35 | 1.09 | 1.09 | 27 | | | |
| *Average 1980–1997* | | | | | | | | | | | | | | | |
| | **10.67** | **2.10** | | **21.01** | **2.26** | | **7.90** | **1.97** | | **4.01** | **1.82** | | **5.82** | **2.41** | |
| *B: Raw multiples for firms having an accquisitions/buyout* | | | | | | | | | | | | | | | |
| 1988 | | | | | | | | | | | | | | | |
| 1989 | 22.33 | 1.56 | 1 | | | | | | | | | | | | |
| 1990 | | | | | | | | | | | | | | | |
| 1991 | | | | 3.82 | 1.56 | 1 | | | | | | | | | |
| 1992 | | | | 2.70 | 1.28 | 1 | 2.81 | 1.68 | 1 | | | | | | |
| 1993 | 10.22 | 1.39 | 1 | 2.27 | 1.31 | 1 | 0.52 | 0.90 | 1 | 15.65 | 1.72 | 2 | | | |
| 1994 | | | | 2.19 | 1.48 | 1 | 1.50 | 1.22 | 1 | 0.80 | 0.92 | 2 | | | |
| 1995 | | | | | | | 8.27 | 4.80 | 2 | 0.42 | 0.80 | 1 | 2.31 | 1.52 | 1 |
| 1996 | | | | 26.53 | 4.52 | 3 | 0.76 | 0.88 | 2 | 2.54 | 1.35 | 2 | | | |
| 1997 | | | | 5.50 | 2.60 | 4 | 2.33 | 1.87 | 6 | 3.63 | 1.41 | 6 | | | |
| 1998 | 1.05 | 1.02 | 1 | 3.00 | 2.58 | 2 | 5.05 | 1.74 | 5 | 12.56 | 1.49 | 2 | | | |
| 1999 | | | | 5.22 | 5.22 | 4 | 5.11 | 3.60 | 13 | 4.46 | 4.46 | 4 | 4.28 | 4.28 | 1 |
| 2000 | | | | 3.72 | 3.72 | 1 | 1.99 | 1.99 | 5 | 2.20 | 2.20 | 2 | 2.18 | 2.18 | 1 |
| *Average 1980–1997* | | | | | | | | | | | | | | | |
| | **16.28** | **1.48** | | **10.23** | **2.69** | | **2.83** | **2.03** | | **4.63** | **1.33** | | **2.31** | **1.52** | |

*C: Industry adjusted multiples for firms having an IPO*

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1984 | | | | | | | 1.27 | 1.02 | 1 | | | | | | |
| 1985 | | | | | | | | | | | | | | | |
| 1986 | | | | 1.41 | 1.04 | 2 | | | | 1.07 | 1.01 | 1 | | | |
| 1987 | | | | 0.90 | 0.90 | 3 | 1.34 | 1.05 | 1 | | | | | | |
| 1988 | | | | 1.73 | 1.17 | 3 | | | | 4.02 | 1.13 | 2 | | | |
| 1989 | | | | 2.30 | 1.26 | 3 | 1.02 | 1.03 | 3 | 0.48 | 0.83 | 1 | | | |
| 1990 | | | | 0.99 | 1.01 | 3 | | | | 0.94 | 0.97 | 5 | | | |
| 1991 | 1.87 | 1.37 | 1 | 14.10 | 1.47 | 5 | 1.60 | 1.00 | 5 | 1.35 | 1.09 | 2 | | | |
| 1992 | 1.32 | 1.32 | 2 | 3.37 | 1.35 | 7 | 5.13 | 1.16 | 11 | 2.15 | 1.30 | 11 | | | |
| 1993 | | | | 4.01 | 1.25 | 10 | 2.83 | 1.33 | 15 | 2.05 | 1.94 | 7 | | | |
| 1994 | 14.71 | 1.96 | 1 | 4.43 | 1.35 | 19 | 2.78 | 1.25 | 15 | 1.76 | 1.32 | 11 | 4.22 | 2.06 | 1 |
| 1995 | 1.45 | 1.20 | 1 | 10.12 | 1.72 | 27 | 6.08 | 2.10 | 27 | 4.35 | 2.40 | 8 | | | |
| 1996 | 2.68 | 1.82 | 5 | 17.43 | 1.95 | 87 | 5.73 | 1.44 | 48 | 2.70 | 1.53 | 32 | | | |
| 1997 | 13.47 | 2.17 | 13 | 25.65 | 2.64 | 65 | 6.97 | 2.01 | 105 | 3.65 | 1.79 | 50 | | | |
| 1998 | 4.27 | 3.36 | 6 | 28.69 | 4.70 | 67 | 4.75 | 2.66 | 110 | 4.07 | 2.99 | 73 | 2.29 | 1.36 | 3 |
| 1999 | 7.02 | 5.64 | 4 | 8.67 | 4.27 | 25 | 4.43 | 3.22 | 128 | 2.87 | 2.72 | 131 | | | |
| 2000 | | | | 0.98 | 0.98 | 3 | 1.55 | 1.55 | 35 | 1.19 | 1.19 | 26 | | | |
| *Average 1980–1997* | | | | | | | | | | | | | | | |
| | **9.10** | **1.94** | | **15.79** | **1.96** | | **5.73** | **1.73** | | **2.91** | **1.62** | | **4.22** | **2.06** | |

*D: Industry adjusted multiples for firms having an accquisitions/buyout*

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1988 | | | | | | | | | | | | | | | |
| 1989 | 5.71 | 1.28 | 1 | | | | | | | | | | | | |
| 1990 | | | | | | | | | | | | | | | |
| 1991 | | | | 1.82 | 1.22 | 1 | | | | | | | | | |
| 1992 | | | | 1.26 | 1.06 | 1 | 2.04 | 1.43 | 1 | 6.26 | 1.42 | 2 | | | |
| 1993 | 4.66 | 1.25 | 1 | 1.20 | 1.06 | 1 | 0.24 | 0.79 | 1 | | | | | | |
| 1994 | | | | 1.35 | 1.16 | 1 | 0.91 | 0.95 | 1 | 0.77 | 0.89 | 2 | | | |
| 1995 | | | | | | | 6.02 | 4.01 | 2 | 0.29 | 0.73 | 1 | 1.46 | 1.21 | 1 |
| 1996 | | | | 23.54 | 4.13 | 3 | 0.60 | 0.72 | 2 | 1.82 | 1.22 | 2 | | | |
| 1997 | | | | 3.62 | 2.12 | 4 | 1.83 | 1.64 | 6 | 2.57 | 1.28 | 6 | | | |
| 1998 | 0.84 | 0.92 | 1 | 2.45 | 2.11 | 2 | 4.18 | 1.55 | 5 | 0.06 | 0.06 | 2 | | | |
| 1999 | | | | 4.21 | 4.21 | 4 | 3.69 | 2.91 | 13 | 3.33 | 3.33 | 4 | 3.45 | 3.45 | 1 |
| 2000 | | | | 6.62 | 6.62 | 1 | 2.40 | 2.40 | 5 | 2.81 | 2.81 | 2 | 2.65 | 2.65 | 1 |
| *Average 1980–1997* | | | | | | | | | | | | | | | |
| | **5.19** | **1.26** | | **6.72** | **2.12** | | **2.11** | **1.73** | | **2.57** | **1.19** | | **1.46** | **1.21** | |

The valuation multiples categorized by the year in which financing was received. Panels A and B present raw multiples when firms had an IPO or a buyout/accquisition. Panels C and D present industry adjusted multiples. The "raw" mutliple is computed as the ratio of the post-money value of the firm when it exits to the post-money valuation it received at the time of financing. The annualized multiple is the raw mutliple annualized to the nearest year. Corresponding industry adjusted multiples are the ratio of the raw multiples and performance of publicly traded firms in the same industry.

noticeable for both multiples and annualized returns. Multiples for buyout stage firms are slightly higher than those for expansion stage firms. It is worth noting that multiples are often high, and the average for early-stage firms is about 21, whereas the annualized average multiple for the same firm is a little greater than 2. This drops to about 4.01 (annualized 1.82) for later-stage firms. There is wide variation in multiples across all the years we examined, and there is little evidence of a time trend over the past decade.

Panel B summarizes results for acquired firms, and the pattern of decreasing multiples as we progress from early- to late-stage firms is evident here as well. This pattern confirms the expected relationship between risk and return: firms in early stages bear much greater risk *ex-ante*. However, a distinctive finding is that the multiples for acquired firms are usually lower than those for IPOs. Average multiples range from about 10.0 for early-stage firms to about 4.6 for later-stage companies. Buyout-stage firms have higher multiples. Once again, there is very high time series variation in multiples. A lower multiple for a firm which exits through an acquisition is in no way suggestive of a sub-optimal exit strategy.[15]

Panel C of Table 6 corresponds to Panel A, but presents the results after adjusting for returns that may be attributed to the industry. This results in a reduction in multiples, with IPOs ranging from 15.79 for early-stage financings to 2.91 for later-stage rounds. The multiples for acquisitions are much lower, ranging from 6.72 in early stages to 2.57 in later rounds, as can be seen in Panel D.

Table 7 presents exit multiples by industry segment. There is substantial cross-sectional variation in the data. For IPOs, the semiconductor, communications, and Internet segments evidence the highest multiples, followed closely by the software and hardware segments. A similar pattern is seen in the case of buyout exits, where hardware, software, Internet, and communications were the segments with the highest exit multiples.

In unreported results, we estimated exit multiples after stratifying the sample by financing round. For early-stage financings, the multiples drop rapidly as the round number increases, corresponding to the perceived risk at early rounds. This effect cuts across IPO and acquisition exits. The effect exists, though is weaker for the expansion- and later-stage financing rounds.

We also examined exit multiples when the data are stratified by deciles of financing amount. For firms exiting via an IPO, the multiples are higher for smaller financings. This effect is more marked for early-stage firms than for later-stage firms. The fact that a firm invests little, yet makes it to an IPO, would naturally result in greater multiples. For exits via acquisition, there appears to no such effect.

Finally, we examined exit multiples for data stratified by the post-money valuation amount. Since multiples are calculated as a function of the post-money amount, there is a natural inverse relationship here. This is borne out in the data we looked at.

## 5 Expected multiples

### *5.1 Methodology*

To estimate the expected multiple, we proceed as follows. Denote the $i$th multiple in stage $j$ in year $t$ by $X_{ijt}$, $i = 1, \ldots, N_{jt}$, $j \in J$, $t = 1, \ldots, T$, where $N_{jt}$ is the number of financings in stage $j$ in year $t$ and $T$ is the number of years in the database. Stage $j$ is a choice from the set $J$={early, expansion, late, buyout, other}. For each set of financing multiples $X_{ijt}$, we compute the expected exit multiple as follows:

$$\begin{aligned}\text{Expected exit multiple } (j,t|\text{IPO or ACQ}) &= E(X_{jt}|\text{IPO or ACQ}) \\ &= p(j,t|\text{IPO or ACQ}) \times \frac{\Sigma_i X_{ijt}}{N_{jt}}\end{aligned}$$

**Table 7** Valuation multiples categorized by industry

| Year | Buyout/acqusition | | | Early stage | | | Expansion stage | | | Later stage | | | Others | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Annualized | Frequency | Raw | Annualized | Frequency | Raw | Annualized | Frequency | Raw | Annualized | Frequency | Raw | Annualized | Frequency |
| ***A: Raw multiples for firms having an IPO*** | | | | | | | | | | | | | | | |
| Biotechnology | | | | 2.39 | 1.13 | 28 | 1.34 | 1.07 | 53 | 1.83 | 1.25 | 31 | | | |
| Business services | 3.23 | 1.48 | 1 | 5.40 | 1.47 | 3 | 5.59 | 2.74 | 6 | | | | | | |
| Communications | 6.79 | 4.65 | 8 | 21.83 | 2.79 | 50 | 5.70 | 2.76 | 63 | 3.02 | 1.92 | 63 | 3.35 | 1.83 | 2 |
| Computer hardware | 3.31 | 1.82 | 1 | 7.17 | 1.88 | 9 | 4.56 | 2.17 | 12 | 2.14 | 1.78 | 14 | 2.20 | 1.24 | 2 |
| Computer other | | | | 1.21 | 1.07 | 2 | 1.54 | 1.03 | 4 | | | | | | |
| Computer software | 0.65 | 0.65 | 1 | 11.62 | 2.07 | 56 | 3.21 | 1.58 | 83 | 2.81 | 2.17 | 85 | | | |
| Consumer related | 1.73 | 1.28 | 3 | 0.98 | 0.99 | 6 | 14.30 | 2.11 | 15 | 2.43 | 1.26 | 8 | | | |
| Finance/insurance/ real estate | | | | 0.85 | 0.96 | 1 | | | | 0.48 | 0.48 | 1 | | | |
| Industrial/energy | 1.28 | 1.16 | 2 | 5.73 | 1.50 | 6 | 1.97 | 1.83 | 11 | 2.86 | 2.44 | 9 | | | |
| Internet specific | 3.67 | 2.16 | 7 | 17.36 | 3.63 | 132 | 6.60 | 3.29 | 176 | 3.76 | 2.94 | 125 | | | |
| Manufacturing | 6.08 | 2.47 | 1 | | | | | | | | | | | | |
| Medical/health | 4.51 | 2.22 | 7 | 3.17 | 1.22 | 22 | 1.43 | 1.12 | 44 | 1.00 | 0.92 | 15 | | | |
| Semiconductor/ other | 65.19 | 3.38 | 2 | 110.25 | 3.61 | 14 | 5.87 | 1.88 | 37 | 3.97 | 3.68 | 9 | | | |
| ***B: Raw multiples for firms having an accquisitions/buyout*** | | | | | | | | | | | | | | | |
| Biotechnology | 4.66 | 1.25 | 1 | 2.91 | 2.91 | 1 | 0.39 | 0.61 | 3 | 1.24 | 0.95 | 4 | | | |
| Business services | | | | | | | 3.26 | 1.48 | 1 | | | | | | |
| Communications | | | | 3.78 | 3.22 | 5 | 2.89 | 2.79 | 6 | 4.43 | 2.36 | 4 | | | |
| Computer hardware | | | | 1.35 | 1.16 | 1 | 5.20 | 2.09 | 3 | 5.25 | 2.41 | 3 | 1.46 | 1.21 | 1 |
| Computer software | 0.84 | 0.92 | 1 | 9.32 | 2.21 | 6 | 3.47 | 2.26 | 10 | 1.47 | 1.53 | 4 | 2.65 | 2.65 | 1 |
| Internet specific | | | | 4.65 | 4.65 | 3 | 2.32 | 2.30 | 7 | 4.08 | 4.08 | 1 | 3.45 | 3.45 | 1 |
| Medical/health | 5.71 | 1.28 | 1 | 2.52 | 1.59 | 1 | 3.79 | 1.78 | 2 | 1.25 | 1.00 | 2 | | | |
| Semiconductor/ other | | | | | | | 3.17 | 3.10 | 2 | 0.77 | 0.89 | 2 | | | |
| ***C: Industry adjusted multiples for firms having an IPO*** | | | | | | | | | | | | | | | |
| Biotechnology | | | | 4.14 | 1.32 | 28 | 2.02 | 1.25 | 54 | 2.55 | 1.46 | 31 | | | |
| Business services | 5.51 | 1.77 | 1 | 10.07 | 1.74 | 3 | 7.16 | 3.04 | 6 | | | | | | |
| Communications | 8.65 | 5.55 | 8 | 32.59 | 3.32 | 50 | 8.32 | 3.18 | 64 | 3.89 | 2.13 | 64 | 4.40 | 2.10 | 2 |
| Computer hardware | 5.21 | 2.28 | 1 | 11.74 | 2.16 | 9 | 7.23 | 2.59 | 12 | 2.46 | 1.98 | 14 | 3.07 | 1.49 | 2 |
| Computer other | | | | 2.12 | 1.24 | 2 | 2.35 | 1.19 | 4 | | | | | | |
| Computer software | 0.97 | 1.00 | 2 | 20.12 | 2.43 | 57 | 4.75 | 1.88 | 86 | 3.76 | 2.57 | 85 | | | |
| Consumer related | 2.16 | 1.41 | 3 | 2.61 | 1.15 | 6 | 12.32 | 2.17 | 15 | 4.10 | 1.38 | 8 | | | |

**Table 7** (*Continued*)

| Year | Buyout/acqusition | | | Early stage | | | Expansion stage | | | Later stage | | | Others | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Annualized | Frequency | Raw | Annualized | Frequency | Raw | Annualized | Frequency | Raw | Annualized | Frequency | Raw | Annualized | Frequency |
| Finance/insurance/ real estate | | | | 1.87 | 1.17 | 1 | | | | 0.36 | 0.36 | 1 | | | |
| Industrial/energy | 1.69 | 1.33 | 2 | 7.69 | 1.56 | 6 | 2.09 | 1.80 | 11 | 2.99 | 2.55 | 9 | | | |
| Internet specific | 4.54 | 2.50 | 7 | 24.19 | 4.33 | 133 | 8.61 | 3.97 | 176 | 4.33 | 3.38 | 129 | | | |
| Manufacturing | 5.06 | 2.25 | 1 | | | | | | | | | | | | |
| Medical/health | 6.87 | 2.23 | 7 | 5.18 | 1.56 | 22 | 2.05 | 1.25 | 44 | 1.26 | 1.06 | 16 | | | |
| Semiconductor/ other | 67.80 | 3.53 | 2 | 54.15 | 4.00 | 15 | 8.11 | 1.97 | 37 | 4.78 | 4.33 | 9 | | | |
| ***D: Industry adjusted multiples for firms having an accquisitions/buyout*** | | | | | | | | | | | | | | | |
| Biotechnology | 10.22 | 1.39 | 1 | 3.66 | 3.66 | 1 | 0.74 | 0.86 | 3 | 2.09 | 1.25 | 4 | | | |
| Business services | | | | | | | 2.61 | 1.38 | 1 | | | | | | |
| Communications | | | | 4.30 | 3.15 | 5 | 3.25 | 3.07 | 6 | 5.86 | 2.25 | 4 | | | |
| Computer hardware | | | | 2.19 | 1.48 | 1 | 6.80 | 2.82 | 5 | 14.57 | 2.89 | 4 | 2.31 | 1.52 | 1 |
| Computer software | 1.05 | 1.02 | 1 | 13.64 | 2.78 | 7 | 4.49 | 2.79 | 10 | 1.76 | 1.69 | 4 | 2.18 | 2.18 | 1 |
| Internet specific | | | | 5.75 | 5.75 | 3 | 2.53 | 2.45 | 7 | 6.28 | 6.28 | 1 | 4.28 | 4.28 | 1 |
| Medical/health | 22.33 | 1.56 | 1 | 3.09 | 1.76 | 1 | 5.66 | 2.20 | 2 | 1.29 | 1.03 | 2 | | | |
| Semiconductor/ other | | | | | | | 3.09 | 2.98 | 2 | 0.80 | 0.92 | 2 | | | |

The valuation multiples categorized by the industry in which the firm being financed operates. Panels A and B present raw multiples when firms had an IPO or a buyout/accquisition. Panels C and D present industry adjusted multiples. The "raw" mutliple is computed as the ratio of the post-money value of the firm when it exits to the post-money valuation it received at the time of financing. The annualized multiple is the raw mutliple annualized to the nearest year. Corresponding industry adjusted multiples are the ratio of the raw multiples and performance of publicly traded firms in the same industry.

which follows from the fact that the multiple for failure to exit is zero. Denote the $i$th multiple in stage $j$ in industry $k$ by $X_{ijk}$, $i = 1,\ldots, N_{jk}$, $jinJ$, $k = 1,\ldots, K$, where $N_{jk}$ is the number of financings in stage $j$ in industry $k$ and $K$ is the number of industry categories in the database. For each set of financing multiples $X_{ijk}$, we compute the expected exit multiple as follows:

$$\text{Expected exit multiple } (j,k|\text{IPO or ACQ})$$
$$= E(X_{jk}|\text{IPO or ACQ})$$
$$= p(j,k|\text{IPO or ACQ}) \times \frac{\Sigma_i X_{ijk}}{N_{jk}}$$

Note that the expected multiple is an equally weighted multiple.

Finally, we compute the overall expected multiple. Each new firm either exits its private status, or fails to make it to the public company stage. Exit occurs in two forms: (i) IPO and (ii) buyout/acquisition by another firm. The expected multiple $X_j$ on firm $j$ from funding round to exit is stated in the following return equations:

$$E[X_{jt}] = E[X_{jt}|IPO] + E[Xjt|ACQ]$$
$$E[X_{jk}] = E[X_{jk}|IPO] + E[Xjk|ACQ]$$

These two equations are for the data analyzed by year of financing and by industry category, respectively.

### *5.2 Expected multiples*

Table 8 presents the industry adjusted expected multiples by year of financing. We notice considerable variation in multiples across the time series. Panel A contains industry adjusted multiples for both IPOs and acquisitions, and Panel B contains the expected industry adjusted multiples, which are obtained by multiplying the probability of exit by the exit multiple.

First, notice that expected multiples from early-stage financing tend to be much higher than those from the other stages, presumably as a result of the higher risk borne by the private equity investor at this stage of the process. The higher discounts apply to early-stage investments and become correspondingly lower for later-stage financings. Notice also that there are many years where the expected multiple is less than one, that is, a negative return. However, in the later years in the sample this is not the case, and large multiples were earned in the 1990s.

Cochrane (2001) has argued that high levels of return may simply be on account of another form of selection bias, that is, firms go public only when they have achieved a high rate of return. He finds that failure to correct for this bias results in average returns in the 700% range. After implementing a correction for exit probability, the arithmetic average returns result in levels in the 50% range. Our sample is fairly comprehensive, and we have a large number of firms that do not result in exits, from which we carefully compute the survival probability. By breaking the sample into buckets, we also believe that the correlation between stage of financing, vintage, and industry with returns is captured in a meaningful way. Hence, we believe that the bias is mitigated. Indeed, we do obtain returns at levels close to those obtained by Cochrane after making the selection bias correction.

Returns may be high because the period studied was one of hot IPO markets, as well as an active M&A market. This may have fueled highly priced exits, with the resultant high return levels.

High returns also reflect the fact that private equity is non-traded, and comes with minimal supervision. Hence, there is a concomitantly appropriate rate of return. Moskowitz and Vissing-Jorgenssen state that 66% of private companies fail in their first 10-years. All these factors would lead to higher rates of required return on private equity, reflected in the discount charged at the time the venture capitalist invests in these firms.

Table 9 presents the industry adjusted expected multiples by industry segment. There is substantial

**Table 8** Expected Private Equity Multiples by Year of Financing

| Year | Buyout/acqusition | | | Early stage | | | Expansion stage | | | Later stage | | | Others | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Annualized | Frequency | Raw | Annualized | Frequency | Raw | Annualized | Frequency | Raw | Annualized | Frequency | | | |
| *A: Industry adjusted multiples for firms having an IPO or an acquisition/buyout* | | | | | | | | | | | | | | | |
| 1984 | | | | | | | 1.27 | 1.02 | 1 | | | | | | |
| 1985 | | | | | | | | | | 1.07 | 1.01 | 1 | | | |
| 1986 | | | | 1.41 | 1.04 | 2 | | | | | | | | | |
| 1987 | | | | 0.90 | 0.90 | 3 | 1.34 | 1.05 | 1 | | | | | | |
| 1988 | | | | 1.73 | 1.17 | 3 | | | | 4.02 | 1.13 | 2 | | | |
| 1989 | 5.71 | 1.28 | 1 | 2.30 | 1.26 | 3 | 1.02 | 1.03 | 3 | 0.48 | 0.83 | 1 | | | |
| 1990 | | | | 0.99 | 1.01 | 3 | | | | 0.94 | 0.97 | 5 | | | |
| 1991 | 1.87 | 1.37 | 1 | 12.05 | 1.43 | 6 | 1.60 | 1.00 | 5 | 1.35 | 1.09 | 2 | | | |
| 1992 | 1.32 | 1.32 | 2 | 3.10 | 1.31 | 8 | 4.87 | 1.18 | 12 | 2.79 | 1.32 | 13 | | | |
| 1993 | 4.66 | 1.25 | 1 | 3.76 | 1.23 | 11 | 2.67 | 1.29 | 16 | 2.05 | 1.94 | 7 | | | |
| 1994 | 14.71 | 1.96 | 1 | 4.27 | 1.34 | 20 | 2.66 | 1.23 | 16 | 1.60 | 1.25 | 13 | 4.22 | 2.06 | 1 |
| 1995 | 1.45 | 1.20 | 1 | 10.12 | 1.72 | 27 | 6.07 | 2.24 | 29 | 3.90 | 2.21 | 9 | 1.46 | 1.21 | 1 |
| 1996 | 2.68 | 1.82 | 5 | 17.57 | 2.00 | 89 | 5.52 | 1.41 | 50 | 2.65 | 1.51 | 34 | | | |
| 1997 | 13.47 | 2.17 | 13 | 24.37 | 2.61 | 69 | 6.69 | 1.99 | 111 | 3.54 | 1.73 | 56 | | | |
| 1998 | 3.78 | 3.01 | 7 | 27.93 | 4.63 | 69 | 4.72 | 2.61 | 115 | 4.01 | 2.95 | 74 | 2.29 | 1.36 | 3 |
| 1999 | 7.02 | 5.64 | 4 | 8.06 | 4.26 | 29 | 4.37 | 3.19 | 140 | 2.89 | 2.74 | 135 | 3.45 | 3.45 | 1 |
| 2000 | | | | 2.39 | 2.39 | 4 | 1.64 | 1.64 | 39 | 1.30 | 1.30 | 28 | 2.65 | 2.65 | 1 |
| *Average 1984–1997* | | | | | | | | | | | | | | | |
| | **8.78** | **1.88** | | **15.42** | **1.97** | | **5.54** | **1.73** | | **2.88** | **1.58** | | **2.84** | **1.63** | |
| *B: Expected private equity multiples* | | | | | | | | | | | | | | | |
| 1984 | | | | | | | 0.36 | 9.15 | 0.89 | | | | | | |
| 1985 | | | | | | | | | | 0.43 | 10.99 | 0.93 | | | |
| 1986 | | | | 0.36 | 6.64 | 0.86 | | | | | | | | | |
| 1987 | | | | 0.25 | 6.40 | 0.81 | 0.39 | 5.18 | 0.83 | | | | | | |
| 1988 | | | | 0.64 | 4.83 | 0.91 | | | | 1.43 | 5.81 | 1.06 | | | |
| 1989 | 1.36 | 6.76 | 1.05 | 0.86 | 2.61 | 0.94 | 0.39 | 5.70 | 0.85 | 0.21 | 3.63 | 0.65 | | | |
| 1990 | | | | 0.41 | 4.29 | 0.81 | | | | 0.53 | 2.35 | 0.76 | | | |
| 1991 | 0.72 | 1.15 | 0.75 | 5.69 | 3.26 | 1.70 | 0.73 | 5.27 | 0.94 | 0.74 | 1.14 | 0.77 | | | |
| 1992 | 0.55 | 0.65 | 0.40 | 1.39 | 3.58 | 1.10 | 2.38 | 2.94 | 1.34 | 1.43 | 1.98 | 1.20 | | | |
| 1993 | 2.02 | 6.58 | 1.11 | 1.80 | 3.54 | 1.18 | 1.19 | 2.89 | 1.06 | 1.03 | 1.56 | 1.02 | | | |
| 1994 | 5.31 | 3.68 | 1.57 | 1.98 | 2.84 | 1.27 | 1.17 | 2.54 | 1.06 | 0.65 | 1.81 | 0.79 | 1.06 | 1.02 | 1.05 |
| 1995 | 0.44 | 1.84 | 0.64 | 3.86 | 3.33 | 1.50 | 2.69 | 1.70 | 1.79 | 2.01 | 1.85 | 1.46 | 0.33 | 1.27 | 0.42 |
| 1996 | 0.76 | 1.37 | 0.82 | 6.78 | 3.03 | 1.88 | 2.13 | 2.10 | 1.44 | 1.17 | 1.62 | 1.10 | | | |
| 1997 | 2.76 | 1.68 | 1.83 | 6.24 | 2.39 | 2.15 | 2.17 | 2.01 | 1.47 | 1.07 | 1.52 | 1.04 | | | |
| 1998 | 0.51 | 1.25 | 0.59 | 4.93 | 1.56 | 2.77 | 1.19 | 1.33 | 1.14 | 0.91 | 1.13 | 0.92 | 0.05 | 1.31 | 0.10 |
| 1999 | 0.59 | 0.76 | 0.50 | 0.47 | 0.87 | 0.43 | 0.74 | 0.66 | 0.63 | 0.83 | 0.47 | 0.67 | 0.15 | 0.52 | 0.03 |
| 2000 | | | | 0.01 | 0.41 | 0.00 | 0.05 | 0.42 | 0.00 | 0.06 | 0.32 | 0.00 | 0.04 | 0.46 | 0.00 |
| *Average 1984–1997* | | | | | | | | | | | | | | | |
| | **2.03** | | | **5.12** | | | **2.04** | | | **1.12** | | | **0.69** | | |

The expected multiples for our sample firms categorized by the year of financing. Panel A presents the industry adjusted multiple for firms having an IPO or an accquisition/buyout. Panel B presents the expected industry adjusted multiple estimated as the product of the probability of an exit via an IPO or an accquisition/buyout and the industry adjusted multiple.

**Table 9** Expected private equity multiples by industry

| Year | Buyout/acqusition | | | Early stage | | | Expansion stage | | | Later stage | | | Others | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Annualized | Frequency | Raw | Annualized | Frequency | Raw | Annualized | Frequency | Raw | Annualized | Frequency | Raw | Annualized | Frequency |
| ***A: Industry adjusted multiples for firms having an IPO or an acquisition/buyout*** | | | | | | | | | | | | | | | |
| Biotechnology | 4.66 | 1.25 | 1.00 | 2.41 | 1.19 | 29.00 | 1.29 | 1.05 | 56.00 | 1.76 | 1.21 | 35.00 | | | |
| Business services | 3.23 | 1.48 | 1.00 | 5.40 | 1.47 | 3.00 | 5.25 | 2.56 | 7.00 | | | | | | |
| Communications | 6.79 | 4.65 | 8.00 | 20.19 | 2.83 | 55.00 | 5.45 | 2.77 | 69.00 | 3.11 | 1.95 | 67.00 | 3.35 | 1.83 | 2.00 |
| Computer hardware | 3.31 | 1.82 | 1.00 | 6.59 | 1.80 | 10.00 | 4.69 | 2.15 | 15.00 | 2.69 | 1.89 | 17.00 | 1.95 | 1.23 | 3.00 |
| Computer other | | | | 1.21 | 1.07 | 2.00 | 1.54 | 1.03 | 4.00 | | | | | | |
| Computer software | 0.75 | 0.79 | 2.00 | 11.40 | 2.09 | 62.00 | 3.24 | 1.65 | 93.00 | 2.75 | 2.14 | 89.00 | 2.65 | 2.65 | 1.00 |
| Consumer related | 1.73 | 1.28 | 3.00 | 0.98 | 0.99 | 6.00 | 14.30 | 2.11 | 15.00 | 2.43 | 1.26 | 8.00 | | | |
| Finance/insurance/ real estate | | | | 0.85 | 0.96 | 1.00 | | | | 0.48 | 0.48 | 1.00 | | | |
| Industrial/energy | 1.28 | 1.16 | 2.00 | 5.73 | 1.50 | 6.00 | 1.97 | 1.83 | 11.00 | 2.86 | 2.44 | 9.00 | | | |
| Internet specific | 3.67 | 2.16 | 7.00 | 17.07 | 3.65 | 135.00 | 6.43 | 3.25 | 183.00 | 3.76 | 2.95 | 126.00 | 3.46 | 3.45 | 1.00 |
| Manufacturing | 6.08 | 2.47 | 1.00 | | | | | | | | | | | | |
| Medical/health | 4.66 | 2.11 | 8.00 | 3.15 | 1.23 | 23.00 | 1.53 | 1.15 | 46.00 | 1.03 | 0.93 | 17.00 | | | |
| Semiconductor/ other | 65.19 | 3.38 | 2.00 | 110.25 | 3.61 | 14.00 | 5.73 | 1.95 | 39.00 | 3.38 | 3.17 | 11.00 | | | |
| ***B: Expected private equity multiples*** | | | | | | | | | | | | | | | |
| Biotechnology | 2.15 | 6.58 | 1.12 | 0.55 | 2.94 | 0.82 | 0.52 | 1.79 | 0.69 | 0.84 | 1.24 | 0.87 | | | |
| Business services | 0.54 | 2.11 | 0.74 | 0.20 | 3.10 | 0.60 | 0.44 | 1.65 | 0.61 | | | | | | |
| Communications | 1.40 | 1.19 | 1.32 | 0.81 | 2.50 | 0.92 | 0.87 | 1.60 | 0.91 | 1.24 | 1.25 | 1.19 | 0.66 | 1.17 | 0.70 |
| Computer hardware | 0.80 | 1.99 | 0.89 | 0.46 | 2.83 | 0.76 | 0.66 | 2.22 | 0.83 | 0.99 | 1.35 | 0.99 | 0.67 | 1.29 | 0.73 |
| Computer other | | | | 0.41 | 3.72 | 0.79 | 0.58 | 1.77 | 0.73 | | | | | | |
| Computer software | 0.37 | 1.15 | 0.42 | 0.52 | 2.70 | 0.79 | 0.50 | 1.64 | 0.65 | 1.09 | 1.05 | 1.09 | 0.69 | 0.46 | 0.45 |
| Consumer related | 0.32 | 1.47 | 0.46 | 0.17 | 5.79 | 0.73 | 0.44 | 1.48 | 0.58 | 0.66 | 2.74 | 0.86 | | | |
| Finance/insurance/ real estate | | | | 0.13 | 3.22 | 0.53 | | | | 0.17 | 0.33 | 0.00 | | | |
| Industrial/energy | 0.20 | 1.28 | 0.28 | 0.34 | 2.68 | 0.67 | 0.38 | 2.01 | 0.62 | 0.75 | 1.08 | 0.77 | | | |
| Internet specific | 0.79 | 1.37 | 0.84 | 0.47 | 2.00 | 0.68 | 0.56 | 1.11 | 0.60 | 1.14 | 0.70 | 1.21 | 0.45 | 0.52 | 0.21 |
| Manufacturing | 0.70 | 1.10 | 0.72 | | | | | | | | | | | | |
| Medical/health | 1.61 | 2.18 | 1.24 | 0.36 | 2.88 | 0.70 | 0.35 | 2.10 | 0.61 | 0.34 | 1.04 | 0.35 | | | |
| Semiconductor/ other | 20.87 | 1.88 | 5.04 | 1.04 | 3.21 | 1.01 | 0.76 | 1.50 | 0.83 | 1.60 | 2.58 | 1.20 | | | |

The expected multiples for our sample firms categorized by industry. Panel A presents the industry adjusted multiple for firms having an IPO or an accquisition/buyout. Panel B presents the expected industry adjusted multiple estimated as the product of the probability of an exit via an IPO or an accquisition/buyout and the industry adjusted multiple.

industry variation in expected multiples. Communications and the Internet segments account for much higher rates of return than do the other categories. The pattern of stage-based returns seen in Table 8 is also in evidence here—early-stage investments do provide higher levels of return. And returns on IPOs tend to be much higher than returns on buyout firms, again lending credence to the notion that firms that fail to access the public markets are bought out at lower prices.

## 6 Summary and implications

Little is known about the risk and return characteristics of private equity investments. We examine over 52 000 financing rounds by venture and buyout funds and estimate the probability of exit, the expected multiples, and the gains from private equity investments. Our analysis shows that the probability of exit, the valuation multiple, and the expected gains depend upon the industry, the stage of the firm being financed, and the prevailing market sentiment.

In addition to our study being the first comprehensive examination of the gains from venture-backed financing, the results have implications for valuing private companies. Unlike publicly traded firms, a private company has no observable stock price to serve as an objective measure of market value. Therefore, to value private companies, many valuation experts tend to find a set of comparable publicly traded companies and take valuation ratios like price-to-sales or price-to-earnings, and apply these to the observable accounting characteristics of the private companies. They next apply a marketability discount to account for the lack of liquidity, because there does not exist a ready market for these investments. The amount of discount to be applied is often ad-hoc. Our expected exit multiples can provide a guideline about the appropriate amount of marketability discount.

Our empirical results may be used to estimate the marketability discount using the following equations:

$$D_{jt} = 1 - \frac{1}{E[X_{jt}]}$$
$$D_{jk} = 1 - \frac{1}{E[X_{jk}]}$$

As an example, if $E[X] = 1.5$, then $D = 33\%$. We find that financing in late-stage companies, the private equity discounts are about 11%, and for early-stage companies the discounts are 80%.[16] It is important to understand that what we are capturing is more than a non-tradeability discount. The venture capitalists provide an important monitoring and mentoring role to the companies they finance (for evidence on this, see Hellman and Puri, 2000, 2002). They often sit on boards of companies in which they invest, and make available their network to these companies. Thus, almost certainly a part of the return is due to these activities. These high returns are to some extent being driven by success of investments in the new economy companies like Internet businesses, semiconductor, software, and biotech.

The estimation framework of this paper will assist VCs in making portfolio decisions.[17] Our study is the first step in understanding the risk premium required for the valuation of private equity investments. It will be of particular interest to the VC community and valuation practitioners.

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## Notes

1 One notable exception is a contemporaneous paper by Cochrane (2001), which discusses the biases inherent in this kind of analysis.
2 Moskowitz and Vissing-Jorgensen consider the larger market of private companies, not only those that are venture-backed. However, we restricted our focus to a very large sample of purely venture-backed firms, as we believe the results we get are more focused, being based on a homogeneous class of financings. The number of financings in this area are large, and should, therefore, ensure that the results are general to the area.
3 See, for example, Emory (1994).
4 See, for example, Hertzel and Smith (1993).
5 See Koeplin *et al.* (2000).
6 The exit multiple is the ratio of the value of the firm upon successful exit to the amount of financing, making suitable adjustments for dilution. See also Schwienbacher (2002) for an interesting model of the choice of exit route by the venture capitalist. To the best of our knowledge, this paper is the first to carefully account for dilution over a series of financing rounds in the *same* venture. Treating each round as independent of its predecessor would overstate returns, if the dilution from the latest round of financing (and all predecessor rounds) were not correctly adjusted for. We follow each venture and make adjustments for dilution, so as to "follow the first dollar" from inception of the venture to its final exit.
7 It is important to note that we examine private equity in the case of venture-backed firms. This constitutes a subset of the entire private equity in the economy. Our goal is to cast light on the risk and return relationship of venture-financed companies. For a study covering a broader set of private companies, see Moskowitz and Vissing-Jorgensen (2001).
8 For some firms the exit strategy may be liquidation, and others may choose to remain private. In our analysis, these firms are assumed to have failed to exit via a liquidity event.
9 See, for example, Ritter (1991).
10 It is also possible that the data on acquisition is more readily available and completely collected by he Securities Data Corporation in the recent years.
11 See also Gompers (1995).
12 These results are available on request from the authors.
13 Valuations are known to be impacted by the degree of VC involvement. Barry, *et al.* (1990) find that firms with a significant VC stake had much higher probabilities of successful exit, as well as lower IPO underpricing. These are important issues in determining valuation and exit probabilities. Megginson and Weiss (1991) also report that VC reputation has an impact on valuations.
14 Valuation data were unavailable for earlier periods.
15 All through our analysis we are assuming that managers make optimal exit decisions.
16 These are computed from Table 8, wherein the multiples are 1.12 and 5.12, respectively.
17 We make the important observation here that an "estimation" framework does not coincide with the presence of "predictability". We are not positing the existence of ineffciency in the private equity market.

## References

Barry, C.B., Muscarella, C.J., Peavy, J.W., and Vetsuypens, M.R. (1990). "The Role of Venture Capital in the Creation of Public Companies: Evidence from the Going-public Process." *Journal of Financial Economics* 27, 447–471.

Benninga, S., Helmantel, M., and Sarig, O. (2000). "The Timing of Initial Public Offerings." Working paper, Tel-Aviv University.

Black, B. and Gilson, R. (1999). "Does Venture Capital Require an Active Stock Market?" *Journal of Applied Corporate Finance* 37.

Brav, A. and Gompers, P. (1997). "Myth or Reality? The Long-run Underperformance of Initial Public Offerings: Evidence from Venture Capital and Nonventure Capital-Backed Companies." *Journal of Finance* 52, 1791–1822.

Cochrane, J.H. (2001). "The Risk and Return of Venture Capital." Working paper, Graduate School of Business, University of Chicago.

Emory, (1994). "The Value of Marketability as Illustrated in Initial Public Offerings of Common Stock—February 1992 through July 1993." *Business Valuation Review* March, 3–7.

Fama, E.F. and French, K.R. (1993a). "The Cross-section of Expected Stock Returns." *Journal of Finance* 47, 427–465.

Fama, E.F. and French, K.R. (1993b). "Common Risk Factors in the returns of Stocks and Bonds." *Journal of Financial Economics* 33, 3–55.

Fama, E.F. and French, K.R. (1997b). "Industry Costs of Equity." *Journal of Financial Economics* 43, 153–193.

Gompers, P.A. (1995). "Optimal Investment, Monitorin g and the Staging of Venture Capital." *Journal of Finance* 50, 301–318.

Gompers, P.A. (1996). "Grandstanding in the Venture Capital Industry." *Journal of Financial Economics* 43, 293–316.

Gompers, P.A. and Lerner, J. (1997). "Risk and Reward in Private Equity Investments: the Challenge of Performance Assessment." *Journal of Private Equity* 1, 5–12.

Gompers, P.A. and Lerner, J. (1999a). *The Venture Capital Cycle*. Cambridge, MA: MIT Press.

Gompers, P.A. and Lerner, J. (1999b). "The Determinants of Corporate Venture Capital Success: Organized Structure, Incentives, and Complementarities." In: *Concentrated Corporate Ownership* (ed. R. Morek). University of Chicago Press for NBER.

Gompers, P.A. and Lerner, J. (2000a). "Money Chasing Deals? The Impact of Fund Inflows on Private Equity Valuations." *Journal of Financial Economics* 55, 239–279.

Gompers, P.A. and Lerner, J. (2000b). "The Venture Capital Revolution." Working paper, Harvard Business School, June.

Hellman, T. and Puri, M. (2000). "The Interaction Between Product Market and Financing Strategy: the Role of Venture Capital." *Review of Financial Studies* 13, 959–984.

Hellman, T. and Puri, M. (2002). "Venture Capital and the Professionalization of Start-up Firms: Empirical Evidence." *Journal of Finance* 57, 169–197.

Hertzel, M. and Smith, R.L. (1993). "Market Discounts and Shareholder Gains for Placing Equity Privately." *Journal of Finance* XLVIII 459–485.

Kaplan, S. and Stromberg, P. (2002). "Characteristics, Contracts, and Actions: Evidence from Venture Capital Analyses." Unpublished working paper, University of Chicago, Graduate School of Business.

Koeplin, J., Sarin, A. and Shapiro, A. (2000). "The Private Company Discount." *Journal of Applied Corporate Finance* Winter, 94–101.

Jensen, M.C. and Meckling, W.H. (1976). "A Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure." *Journal of Financial Economics* 3, 305–360.

Lerner, J. (1994). "Venture Capitalists and the Decision to go Public." *Journal of Financial Economics* 35, 293–316.

Lerner, J. (1997). "An Empirical Exploration of a Technology Race." *Rand Journal of Economics* 28, 228–247.

Loughran, T. and Ritter, J.R. (1995). "The New Issues Puzzle." *Journal of Finance* 50, 23–51.

Martin, J.D. and Petty, J.W. (1983). "An Analysis of the Performance of Publicly Traded Venture Capital Companies." *Journal of Financial and Quantitative Analysis* 18, 401–410.

Megginson, W.C. and Weiss, K.A. (1991). "Venture Capital Certification in Initial Public Offerings." *Journal of Finance* 46, 879–893.

Moskowitz, T. and Vissing-Jorgenssen, A. (2001). "The Private Equity Premium Puzzle." Working paper, Graduate School of Business, University of Chicago.

Ritter, J.R. (1991). "The Long-run Performance of Initial Public Offerings." *Journal of Finance* 42, 365–394.

Sahlman, W.A. (1990). "The Structure and Governance of Venture Capital Organizations." *Journal of Financial Economics* 27, 473–524.

Schwienbacher, A. (2002). "Innovation and Venture Capital Exists." Unpublished working paper, University of Namur, Belgium.

Silber, W.L. (1991). "Discounts on Restricted Stock: the Impact of Illiquidity on Stock Prices." *Financial Analysts Journal* July–August, 60–64.

Wruck, K.H. (1989). "Equity Ownership Concentration and Firm Value: Evidence from Private Equity Financings." *Journal of Financial Economics* 23, 3–28.