# The surge in late stage VC funding with non-traditional investor participation: analyzing the impact on post-IPO gains

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## EXECUTIVE SUMMARY

With late stage venture capital rounds recently on the rise, and with the increased involvement of non-traditional investors, typically hedge funds or mutual funds, the discussion in the venture capital community centers around whether these two related trends could impact valuations and ultimately post-IPO stock performance of the respective portfolio companies.

The hypothesis presented in this paper is that non-traditional investor participation in pre-IPO funding rounds may ultimately lead to higher valuations, which in turn could suppress post-IPO gains to pre-IPO investors. One may also expect the increase in non-traditional investor to impact public investor gains – this hypothesis is also explored in detail.

This study confirms the cited trends and tests the hypothesis on the correlation between post-IPO performance and non-traditional investor involvement. The 1-day and 3-day returns of companies that went public in the time period of 2004-2013, and across multiple industries, were analyzed against both funding-round characteristics and participating investor characteristics. The same analysis was also done on a subset of tech related companies, being a segment that has become particularly attractive for hedge funds and mutual funds.

The regression results indicate no statistically significant correlations. That is to say that non-traditional investor participation in the investment history of companies going public, and more particularly participation in the late funding stages, is not likely to have an effect on the performance of the company's stock in the period immediately after the IPO. This study was not without data limitations, and while it offers initial insights on this topic, further analysis on a larger dataset is recommended.

## I. INTRODUCTION

The post-IPO stock performance of venture-backed companies has been studied extensively in an attempt to determine the key factors explaining cross-company performance differences. The most prominent studies analyze stock performance as a function of investing firm characteristics. Megginson and Weiss (1991) finds that VC-backed IPOs have higher returns than those without VC involvement. More recently, both Sorenson (2007) and Krishnan et al. (2009) analyze post-IPO performance as a function of VC reputation and find a strong correlation indicating that VCs with strong reputation tend to select better performing firms. The strong interest in relating stock performance to investor characteristics is clear: understanding which investors achieve higher returns helps companies seeking to go public partner with the right investor and helps Limited Partners identify the highest yield funds for investment. Yet research in this field is still in its nascent phase and the impact of investor characteristics on returns is not fully understood. In this paper, I will examine the potential impact of a recent trend in the VC industry, the participation of non-traditional investors, on post-IPO returns.

The VC industry is currently experiencing fast growth, with US VC investments at their highest since 2001 and 2014 Q1 investments totaling $10.7B (Garland, 2014). In particular, there is evidence of a sharp increase in later stage funding rounds, accounting for $5.8B of funds raised in Q1 of 2014 and having grown ~30% since last year (ibid.). This surge appears to be the result of higher participation from non-traditional investors, notably hedge funds and mutual funds (CB Insights, March 2014), reminiscent of the expansion of the mezzanine investment market in the 1990s. Prominent examples of such investors include BlackRock and T. Rowe Price, which have increased their participation in late-stage tech funding from 1 and 6 investments respectively in 2011 to 8 and 16 investments in 2014 (CB Insights, March 2015).

CB Insights reports that non-traditional investors have contributed over $2.4B in funding in 2013 alone (CB Insights, January 2014). Their most common form of participation in funding-rounds has historically been to invest in the funds of VC firm, which in turn are used to invest in portfolio companies. Yet recently their participation model seems to be shifting towards more direct involvement, where they bypass the VC intermediaries altogether and invest directly in companies. Perhaps these non-traditional investors are gaining confidence and the skills needed in direct investing, or perhaps they are merely seeking new opportunities for high returns – there are many possible explanations. Logically, late stage rounds also appear to be the most appealing for these investors to target since companies at those stages are more mature and present lower risk.

The potential implications of this surge in late stage funding, and more specifically non-traditional investor involvement, are also being discussed in the VC community. This trend may have an impact on the realized returns of all players in the value chain including post-IPO investors in public markets.

One hypothesis is that an increased participation of hedge funds and mutual funds may drive up valuations in the rounds close to the IPO as these highly diversified investors have lower return requirements and, perhaps, are more likely to overpay. This is an explanation offered by many Venture Capitalists, including Glenn Solomon from GGV Capital who claims that "as public investors, their return expectations are lower than those of VC's,.. so ...they are also often willing to pay higher prices and are less focused on deal terms than VC's" (TechCrunch, February 2014). A recent Bloomberg article attributes a current surge in tech startup valuations to a "flood of money from unconventional sources", where "hedge funds and mutual funds are paying 15 to 18 times projected sales for the year ahead...[compared] with 10 to

12 times five years ago (Carey and Saitto, 2015). If this observation is true and widespread, there could be a negative impact on their post-IPO prices. The argument here is that one may observe a significant drop from the IPO offer price to the IPO opening price (first trade price) with the former perhaps influenced by high pre-IPO valuations, a prevalent environment of overvaluations in the industry or the perceived surge in demand of non-traditional investor at the IPO. Meanwhile, the opening price reflects the market's valuation of the company. This argument would also be counter to the common trend that IPOs tend be underpriced on average, with stock market prices rising above the IPO offer price (Lowry et al., 2010). A counterargument can be made that IPO investors may disagree with pre-IPO valuations which would exert pressure to suppress the IPO offer price close to market equilibrium and from which the opening price may move in any direction.

Another hypothesis with regard to the effect of non-traditional investor involvement on post-IPO returns is that their involvement may affect public investor returns. One discussed possibility is that these investors are making more calculated and risk-averse investment decisions than VC's, overall betting on healthier companies where stock prices are more likely to increase beyond the IPO opening price. A contrasting argument is that non-traditional investors may be more inclined to push for earlier IPOs where companies may not yet be ready to go public. Hence, companies with non-traditional investor participation may exhibit poorer stock performance in the days immediately following the IPO.

The rest of the paper is organized as follows. In the first section I set up the data and methodology for my analysis. I then present the basic statistics and baseline findings from the analyzed dataset. Subsequently, I conduct the regression analyses of return measures against a set of company and investor characteristics. Finally, research limitations are discussed in detail.

## II. DATA & METHODOLOGY

The hypotheses will be tested by analyzing data from venture-backed companies that have exited through an IPO in the time period 2004-2013. Note that 2014 was excluded as data for 2014 are not yet available in CRSP. Although the cited surge in non-traditional investor participation seems to have been observed very recently and reported in early 2014, a statistical examination of past VC deals may shed some light on its significance and implications. The analysis will span multiple industries and will include regressions of post-IPO returns against factors relating to the characteristics of participating investors and the funding rounds the companies received.

### IPO Sample Construction

Core to this research is adequate data on post-IPO public investor returns and company funding rounds. For the former, I use post-IPO stock price data from the Center for Research in Security Prices (CRSP). For the latter, the Thomson Reuters Securities Data Company database (SDC Platinum) provides company funding history data, including investor names and other characteristics. Capital IQ is used to supplement SDC Platinum data on investor characteristics to more accurately identify non-traditional investors.

SDC Platinum contains data on venture backed deals, an industry that is generally difficult to get reliable information on. From SDC, I obtain data on 1648 venture backed companies that have exited via IPO in the years 2004-2014 (the majority based in the US). This dataset includes companies that are still listed and companies ultimately delisted by being taken private or being acquired. Available information on investor characteristics includes investor participant name, type, preferred sector and stage involvement, size and number of funds raised,

number of companies invested in, and the minimum, maximum and average investment size. Some variables in the data were excluded from the regression due to incompleteness (see Table 2 for the list of variables used). Meanwhile, data on company and investment rounds include company sector classification, date and investment amount of all funding rounds, the name of participants in all rounds and the IPO date.

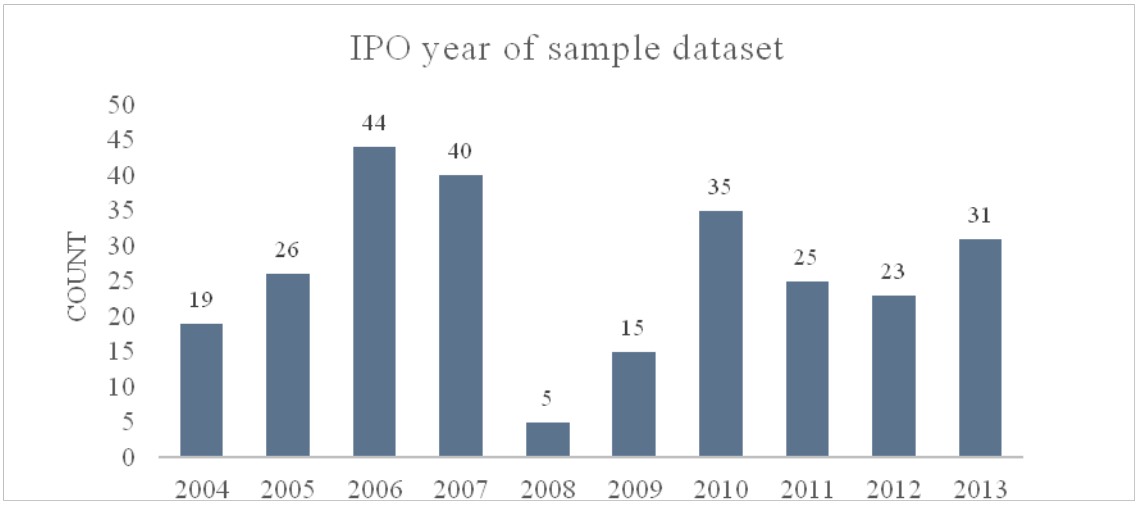
While the SDC data are likely to be the best source of data on VC deals, they are not complete. The identity of investors as well as the round and individual investor amounts are often not disclosed. Added to this limitation is the lack of share price data for 2014 in CRSP. The combined limitations of SDC and CRSP reduce the sample size to 591 companies, of which 263 company entries have complete information on all participating investors. To ensure the highest possible accuracy given data constraints, my analysis focuses on these 263 companies (see Appendix for a list of my sample companies). Note that even here, data on investment amounts are not always complete.

**Table 1:** Analyzed sample characteristics

| **Industry**[1] | **Samples** |
|---|---|
| Medical/Health/Life Science | 34 |
| Biotechnology | 23 |
| Communications and Media | 17 |
| Computer Related | 48 |
| Non-High-Technology | 122 |
| Semiconductors/Other Elect | 19 |
| Total | 263 |

[1] The breakdown follows the industry classification provided by SDC Platinum, but amended to correct some mis-categorizations

**Exhibit 1:** IPO year distribution of analyzed sample set




**Measuring Post-IPO Performance**

For the purpose of my analyses, I use two measures of post-IPO performance. To analyze the impact of non-traditional investor participation on pre-IPO investor gains, I define post-IPO performance as the change in price from the offer price to the closing price on Day 1 of trading, allowing for the price to adjust to the equilibrium, efficient market level. Meanwhile, to test whether non-traditional investor participation in pre-IPO rounds may affect public investor gains, I define post-IPO performance as the change in price from the IPO opening price (first trade price) to the closing price on Day 3. To prevent skewness and outliers from influencing the results, the returns are defined mathematically as the difference between the natural logarithms of the two prices, $\ln(P_T) - \ln(P_0)$, where $P_0$refers to the offer or opening price, and T=1 or T=3, depending on what measure of return is being implemented. Furthermore, the return data need to be normalized for time related factors by normalizing against returns on the S&P 500, defined as $\ln(P_{S\&P,T}) - \ln(P_{S\&P,0})$. Overall the market-adjusted return is measured as $[\ln(P_T) - \ln(P_0)] - [\ln(P_{S\&P,T}) - \ln(P_{S\&P,0})]$. Note that the 3 day measurement period is arbitrary – there is no

evidence that results vary with another chosen time period as long as the IPO opening price and the trend thereafter is captured.

**Regression variables**

The variables against which the measures of return are regressed include both funding round and investor specific variables. These are summarized below.

**Table 2:** Regression variables summary

| Variable | Type | Comments |
|---|---|---|
| Time to IPO (years) | Funding rounds | Time between first round and IPO date measured in years |
| Number of rounds | Funding rounds | Number of rounds before IPO |
| Average number of investors per round | Funding rounds | Average number of investor participants |
| Known total investment amount in company[2] | Funding rounds | Total registered funds raised prior to IPO |
| Presence of bank affiliated investors | Investor | Binary variable to investor type participation |
| Presence of investment management firm | Investor | Binary variable to investor type participation |
| Presence of insurance firm affiliate | Investor | Binary variable to investor type participation |
| Presence of endowment, foundation or pension | Investor | Binary variable to investor type participation |
| Presence of NT investors | Investor | Binary variable to investor type participation |
| Presence of NT investors in late stage | Investor | Binary variable to investor type participation in rounds 3+[3] |

[2] Not all round amount information was disclosed in SDC Platinum

[3] The definition of late stage was set to rounds Series C +

The category ‘non-traditional investor’ consists of four subgroups of investors. These investors are classified as per SDC Platinum’s definition into the categories of ‘Investment Management Firms’, ‘Insurance Firm Affiliates’, ‘Endowments, Foundations and Pension Funds’, as well as ‘Bank Affiliates’. Note that the latter category was filtered using Capital IQ classifications to exclude the venture capital arms of banks.

## III. RESULTS

The results are organized in two sections. In the first section, trends relating to venture capital investment rounds are analyzed. Specifically, two questions are answered: has there been a noticeable surge in late stage rounds in the period 2004-2013, and is there evidence to suggest an increased participation of non-traditional investors? In the second section, the relationship between the measures of post-IPO performance and the characteristics of funding round and participating investors are explored.

### Trends in venture capital investments rounds

Data from SDC Platinum on 1648 venture backed IPOs demonstrates evolving exit characteristics. Average time to IPO has close to doubled to over 9 years in the period 2004-2014, while the average time between rounds has nearly halved to 8 months, suggesting that companies are receiving significantly more funding rounds before going public and marking an increase in late stage financing.

**Exhibit 2:** Average time to IPO in years 2004-2014

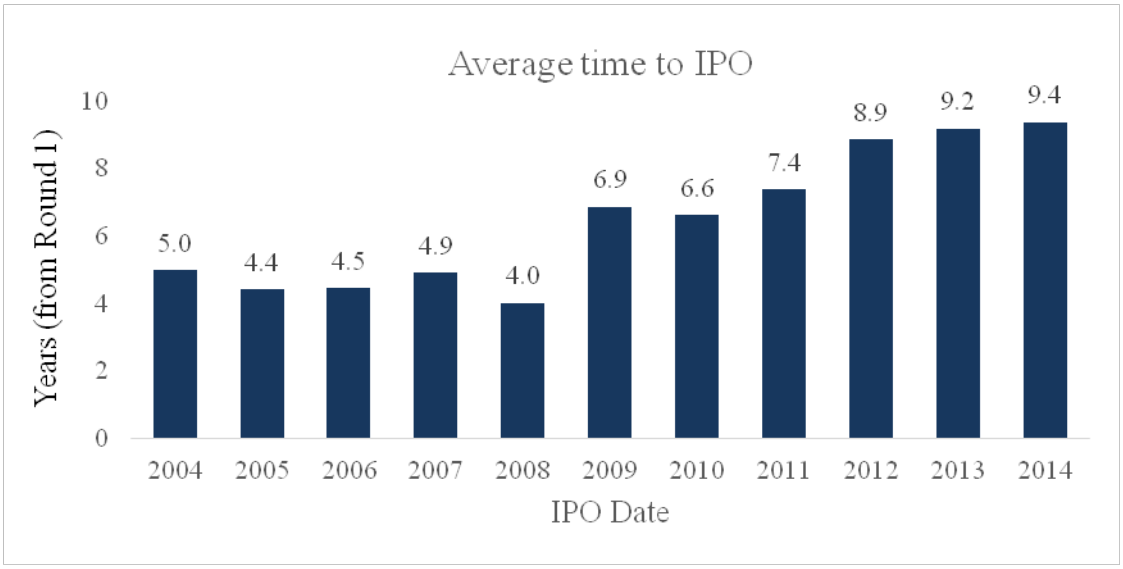
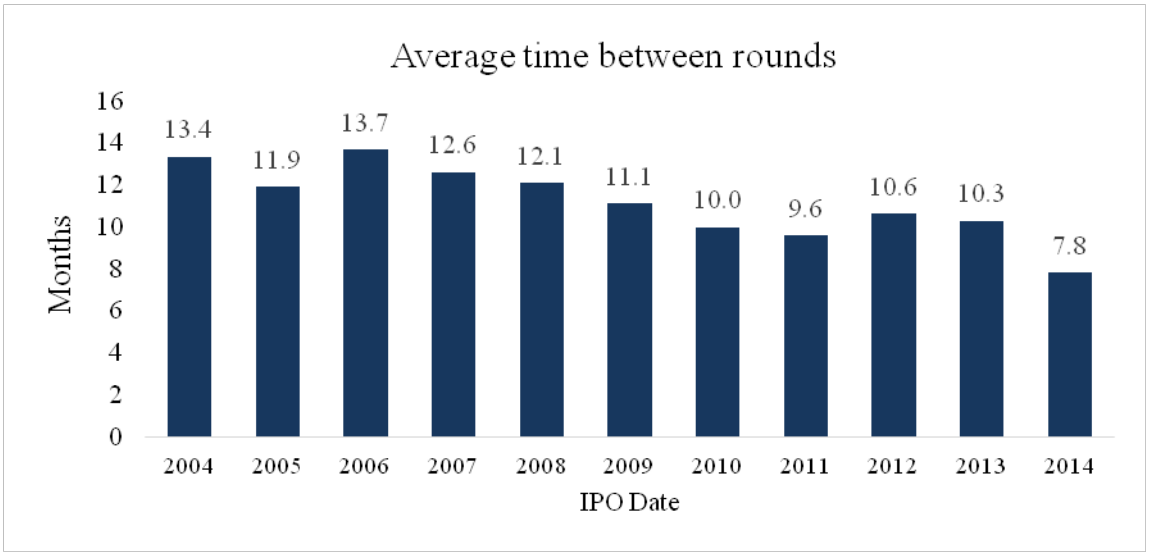
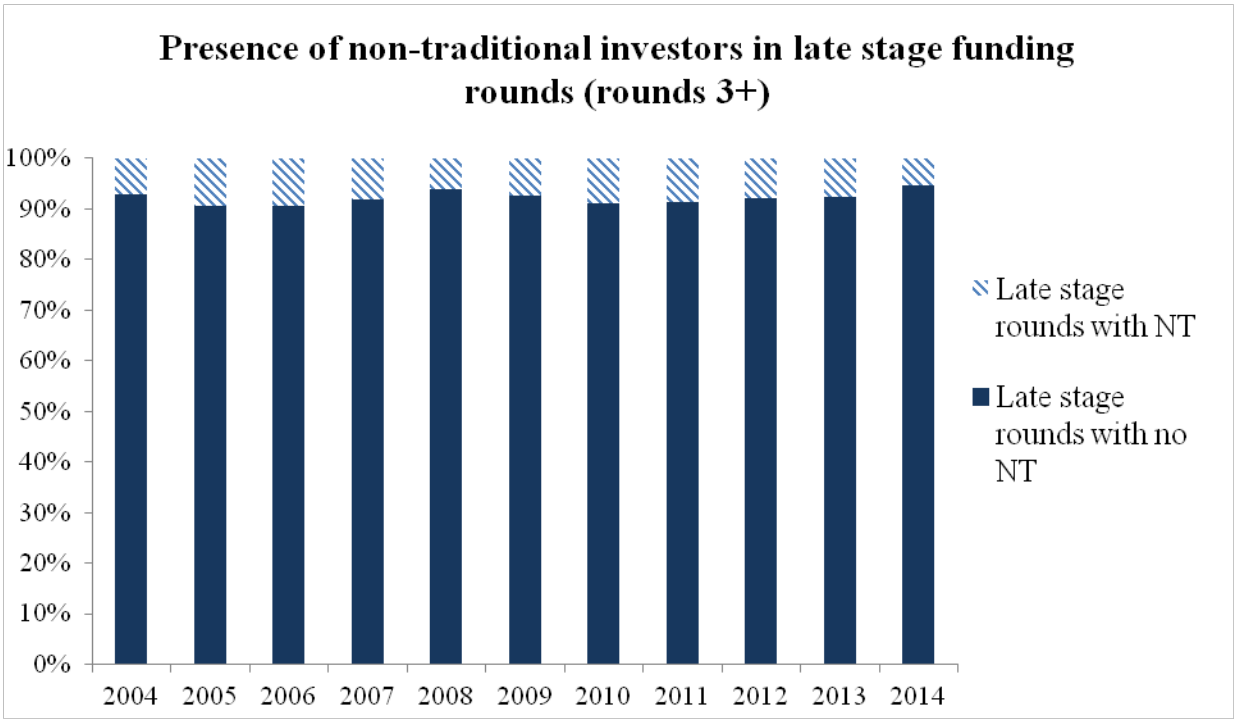



**Exhibit 3:** Average time between funding rounds in years 2004-2014




Participation of non-traditional investors in late stage rounds (Series C+) remains at a low ~10% of deals by count and has been consistent throughout the examined time period. Nevertheless, the observed increase in the average number of rounds to IPO implies a higher degree of non-traditional investor participation in an average company's funding history.

**Exhibit 4:** Non-traditional investor involvement in late stage rounds




**Regression Analysis**

The combined datasets of CRSP and SDC Platinum provide a sample size of 263 IPOs in the time period 2004-2013. This sample spans multiple industries including both High Tech and non-High Tech companies.

The first regression was run on the 1-day return from the IPO offer price versus the set of funding round characteristics as well as a binary indicator of whether at least one non-traditional investor was present in the company's pre-IPO funding history. The goal of the regression is to see if non-traditional investor participation has an effect on pre-IPO investor returns.

The results are summarized in Table 3 below. The estimated coefficients are economically small and statistically insignificant, implying that the examined variables alone are

not sufficient to explain the trend in 1-day post-IPO returns. Most importantly, the presence of a non-traditional investor does not seem to impact post-IPO performance in this sample.

**Table 3:** Regression of 1-day returns against presence of non-traditional investors

| | Adj SS | Adj MS | F-Value | P-Value | Coefficient |
|---|---|---|---|---|---|
| Regression | 0.144 | 0.029 | 0.680 | 0.641 | |
| Time to IPO (years) | 0.011 | 0.011 | 0.260 | 0.611 | 0.002 |
| Number of rounds | 0.053 | 0.053 | 1.240 | 0.267 | 0.004 |
| Average number of investors per round | 0.079 | 0.079 | 1.850 | 0.175 | -0.007 |
| Known total investment amount in company | 0.001 | 0.000 | 0.010 | 0.915 | 0.000 |
| Presence of non-traditional investors | 0.004 | 0.003 | 0.080 | 0.775 | 0.009 |
| R^2 | 1.30% | | | | |
| Adjusted R^2 | 0.00% | | | | |

To determine whether these results reflect an overly broad definition of non-traditional investor participation, I run a regression where the indicator of participation takes on a value of unity only if the investors were present in later funding rounds (Series C+). The results are shown in Table 4 below. They further support the observation that these variables are insignificant contributors to post-IPO performance.

**Table 4:** Regression of 1-day returns against presence of non-traditional investors in late stage rounds (Series C+)

| | Adj SS | Adj MS | F-Value | P-Value | Coefficient |
|---|---|---|---|---|---|
| Regression | 0.1736 | 0.03472 | 0.82 | 0.536 | |
| Time to IPO (years) | 0.0061 | 0.0061 | 0.1400 | 0.7040 | 0.0014 |
| Number of rounds | 0.0355 | 0.0355 | 0.8400 | 0.3610 | 0.0037 |
| Average number of investors per round | 0.0967 | 0.0967 | 2.2800 | 0.1320 | -0.0073 |
| Known total investment amount in company | 0.0002 | 0.0002 | 0.0100 | 0.9420 | 0.0000 |
| Presence of NT investors in late stage | 0.0334 | 0.0334 | 0.7900 | 0.3750 | 0.0410 |
| R^2 | 1.57% | | | | |
| Adjusted R^2 | 0.00% | | | | |

Finally, another version of the regression was run in an attempt to understand whether specific types of non-traditional investors can be shown to be significantly impacting returns (Table 5). Again, results indicate no significant correlations.

**Table 5:** Regression of 1-day returns against presence of specific non-traditional investor types

| | Adj SS | Adj MS | F-Value | P-Value | Coefficient |
|---|---|---|---|---|---|
| Regression | 0.2324 | 0.029046 | 0.68 | 0.707 | |
| Time to IPO (years) | 0.0194 | 0.019382 | 0.46 | 0.501 | 0.0024 |
| Number of rounds | 0.0665 | 0.066506 | 1.56 | 0.213 | 0.0051 |
| Average number of investors per round | 0.0759 | 0.0759 | 1.7800 | 0.1830 | -0.0064 |
| Known total investment amount in company | 0.0000 | 0.0000 | 0.0000 | 0.9880 | 0.0000 |
| Presence of bank affiliated investors | 0.0037 | 0.0037 | 0.0900 | 0.7700 | -0.0123 |
| Presence of investment management firm | 0.0082 | 0.0082 | 0.1900 | 0.6620 | 0.0159 |
| Presence of insurance firm affiliate | 0.0397 | 0.0397 | 0.9300 | 0.3350 | -0.0929 |
| Presence of endowment, foundation or pension | 0.0417 | 0.041741 | 0.98 | 0.323 | -0.211 |
| R^2 | 2.10% | | | | |
| Adjusted R^2 | 0.00% | | | | |

**Technology companies**

A set of analyses was also run on a subset of the sample, including all types of technology companies but excluding the non-high tech category. Tech companies have notably captured hedge and mutual fund interest and are therefore worth exploring separately. The sample size here is 141 companies including Google, Groupon and Kayak.

**Table 6:** Regression of 1-day returns against presence of non-traditional investors in tech companies

| | Adj SS | Adj MS | F-Value | P-Value | Coefficient |
|---|---|---|---|---|---|
| Regression | 0.29127 | 0.058254 | 1.4 | 0.229 | |
| Time to IPO (years) | 0.1242 | 0.1242 | 2.9800 | 0.0870 | 0.0100 |
| Number of rounds | 0.0002 | 0.0002 | 0.0000 | 0.9490 | 0.0004 |
| Average number of investors per round | 0.0711 | 0.0711 | 1.7100 | 0.1940 | -0.0071 |
| Known total investment amount in company | 0.0173 | 0.0173 | 0.4100 | 0.5210 | 0.0000 |
| Presence of non-traditional investors | 0.0339 | 0.0339 | 0.8100 | 0.3690 | 0.0396 |
| R^2 | 4.92% | | | | |
| Adjusted R^2 | 1.40% | | | | |

**Table 7:** Regression of 1-day returns against presence of non-traditional investors in late stage rounds (Series C+) in tech companies

| | Adj SS | Adj MS | F-Value | P-Value | Coefficient |
|---|---|---|---|---|---|
| Regression | 0.26087 | 0.052173 | 1.25 | 0.292 | |
| Time to IPO (years) | 0.1243 | 0.1243 | 2.9700 | 0.0870 | 0.0101 |
| Number of rounds | 0.0000 | 0.0000 | 0.0000 | 0.9820 | -0.0001 |
| Average number of investors per round | 0.0522 | 0.0522 | 1.2400 | 0.2670 | -0.0060 |
| Known total investment amount in company | 0.0226 | 0.0226 | 0.5400 | 0.4640 | 0.0000 |
| Presence of non-traditional investors in late stage | 0.0035 | 0.0035 | 0.0800 | 0.7730 | 0.0161 |
| R^2 | 4.41% | | | | |
| Adjusted R^2 | 0.87% | | | | |

**Table 8:** Regression of 1-day returns against presence of specific non-traditional investor types in tech companies[4]

| | Adj SS | Adj MS | F-Value | P-Value | Coefficient |
|---|---|---|---|---|---|
| Regression | 0.348 | 0.058 | 1.400 | 0.221 | |
| Time to IPO (years) | 0.123 | 0.123 | 2.960 | 0.088 | 0.0100 |
| Number of rounds | 0.000 | 0.000 | 0.000 | 0.973 | 0.0002 |
| Average number of investors per round | 0.056 | 0.056 | 1.340 | 0.250 | -0.0061 |
| Known total investment amount in company | 0.009 | 0.009 | 0.220 | 0.639 | 0.0000 |
| Presence of bank affiliated investors | 0.090 | 0.090 | 2.170 | 0.143 | 0.0879 |
| Presence of investment management firm | 0.000 | 0.000 | 0.000 | 0.964 | -0.0024 |
| R^2 | 5.88% | | | | |
| Adjusted R^2 | 1.66% | | | | |

Although the $R^2$ values appear to be higher on a sample subset level, the results on the tech company data are similarly statistically insignificant. Only the variable 'Time to IPO (years)' appears to have a low P-value; its coefficient is positive, implying that tech companies that go public later are more likely to experience a price increase from the IPO offer price level.

The final set of analysis uses 3-day returns from the IPO opening price (first trade price) as the measure of return in the regressions, in order to study the effect of non-traditional investor participation on public investor post-IPO returns. The results are provided below in Tables 9-11.

[4] Two variables, presence of insurance firm affiliates, and presence of endowment, foundation or pension, were dropped in this analysis due to low sample size

**Table 9:** Regression of 3-day returns against presence of non-traditional investors

| | Adj SS | Adj MS | F-Value | P-Value | Coefficient |
|---|---|---|---|---|---|
| Regression | 0.2125 | 0.042499 | 0.33 | 0.896 | |
| Time to IPO (years) | 0.0096 | 0.009592 | 0.07 | 0.786 | 0.002 |
| Number of rounds | 0.002 | 0.002002 | 0.02 | 0.901 | 0.001 |
| Average number of investors per round | 0.1144 | 0.114377 | 0.88 | 0.349 | -0.008 |
| Known total investment amount in company | 0.0595 | 0.059489 | 0.46 | 0.499 | 0.000 |
| Presence of non-traditional investors | 0.0053 | 0.005305 | 0.04 | 0.840 | 0.011 |
| R^2 | 0.63% | | | | |
| Adjusted R^2 | 0.00% | | | | |

**Table 10:** Regression of 3-day returns against presence of non-traditional investors in late stage rounds (Series C+)

| | Adj SS | Adj MS | F-Value | P-Value | Coefficient |
|---|---|---|---|---|---|
| Regression | 0.3441 | 0.068818 | 0.53 | 0.752 | |
| Time to IPO (years) | 0.0018 | 0.001819 | 0.01 | 0.906 | 0.0007 |
| Number of rounds | 0.0009 | 0.000892 | 0.01 | 0.934 | -0.0006 |
| Average number of investors per round | 0.1701 | 0.17006 | 1.31 | 0.253 | -0.0096 |
| Known total investment amount in company | 0.0508 | 0.050781 | 0.39 | 0.531 | 0.0000 |
| Presence of non-traditional investors in late stage | 0.1369 | 0.136899 | 1.06 | 0.305 | 0.0831 |
| R^2 | 1.02% | | | | |
| Adjusted R^2 | 0.00% | | | | |

**Table 11:** Regression of 3-day returns against presence of specific non-traditional investor types

| | Adj SS | Adj MS | F-Value | P-Value | Coefficient |
|---|---|---|---|---|---|
| Regression | 0.5908 | 0.073851 | 0.57 | 0.803 | |
| Time to IPO (years) | 0.0103 | 0.010256 | 0.08 | 0.779 | 0.0018 |
| Number of rounds | 0.0023 | 0.002346 | 0.02 | 0.893 | 0.0010 |
| Average number of investors per round | 0.1467 | 0.146726 | 1.13 | 0.289 | -0.0089 |
| Known total investment amount in company | 0.0222 | 0.022234 | 0.17 | 0.679 | 0.0000 |
| Presence of bank affiliated investors | 0.1734 | 0.173417 | 1.34 | 0.249 | 0.0850 |
| Presence of investment management firm | 0.0552 | 0.055183 | 0.42 | 0.515 | 0.0412 |
| Presence of insurance firm affiliate | 0.1633 | 0.163344 | 1.26 | 0.263 | -0.188 |
| Presence of endowment, foundation or pension | 0.0474 | 0.047373 | 0.36 | 0.546 | -0.225 |
| R^2 | 1.76% | | | | |
| Adjusted R^2 | 0.00% | | | | |

Again, the regressions indicate no significant correlations between post-IPO public investor gains (measured from the IPO opening price to the closing price on Day 3 of trading) and funding round or investor characteristics. Running the same analysis on 10-day returns provides similar statistically insignificant results and was therefore excluded from this paper.

## IV. CONCLUSION

The analysis presented in this paper confirms the trends taking shape in the venture capital markets. In the time period 2004-2014, the average time to IPO has nearly doubled to 9 years and the average inter-round intervals have halved to 8 months. This implies a surge in late stage funding rounds. The overall participation of non-traditional investors in late stage rounds

remains at a mere ~10% of deals by count, but the increase in late stage rounds has led to more companies having at least one non-traditional investor in their pre-IPO funding history.

With the trends confirmed, this paper then sought to show whether this increase in non-traditional investor activity has any impact on post-IPO stock returns from both a pre-IPO investor and a public investor point of view. On an aggregate level, using a sample size of 263 publicly traded firms, there seem to be no conclusive correlations. I find low $R^2$ values in all regressions, indicating that the analyzed variables alone are not sufficient to explain post-IPO stock performance. More importantly, I cannot reject the null hypothesis that the presence of a non-traditional investor makes no difference to a VC-backed company's post-IPO stock performance in the overall sample.

Analyzing post-IPO gains for the subset of 141 companies operating in the tech sector, I find similarly weak correlations. The P-values remain too low to conclusively establish a significant correlation with pre-IPO investor characteristics.

My initial hypothesis, that the increased participation of non- traditional investors could lead to overvaluation in the rounds immediately preceding IPO and could therefore suppress post-IPO returns from a pre-IPO investor point of view, thus does not find support in the data, whether I analyze the overall sample or tech companies specifically. The hypothesis that the increased participation of non-traditional investors could impact the post-IPO gains from a public investor point of view also does not find support in the data.

It is important to note that my results could be influenced by limited data availability or accuracy. I retrieved data from multiple sources, with many companies having incomplete data or undisclosed investment amounts and investor names. It is also possible that the expected

effect is not yet observable; the venture capital community has only recently begun discussing the impact of investment by non-traditional investors, starting in early 2014. Non-traditional investors may only have started to invest small amounts in the deals, not significantly large enough to influence term sheets and valuations. In any case, this study merits further investigation in the future when more data points become available.

**Limitations**

As with many venture capital research efforts, my analysis faced many data related challenges. In this section, I highlight the limitations my research has encountered in the hope that further research can be conducted on this topic when these limitations can be overcome.

- *Data availability:* This was the largest obstacle in this study. Both CRSP and SDC Platinum, two of the best known finance sources, had a limited datasets. Not all IPOs in the investigated time period were captured in SDC Platinum, while CRSP lacked IPO data on many companies in the original sample. On a more granular level, the databases had a limited set of information available on a company. Where the variables existed in the database, data was missing for many companies. This is likely to be due to the lack of data disclosure by venture capital firms. After filtering companies for completeness of data, the final sample included only 263 companies.
- *Data accuracy:* There were many inconsistencies between databases on many dimensions including IPO dates and company classifications. This is a typical challenge when data is fragmented between multiple sources and there often is no workaround except manual consolidation.

- *Limited research in this field:* It would be inaccurate to say that there is an abundance of precedent research papers in this topic from which to formulate baseline research efforts and seek comprehensive sources of data. This is likely due in part to well-known data limitations, an issue not faced by securities research.

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**APPENDIX: REGRESSION SAMPLE INFORMATION**

| Company Name | Ticker | Industry group (SDC) | IPO year |
|---|---|---|---|
| Accentia BioPharmaceuticals, Inc. | ABPI | Medical/Health/Life Science | 2005 |
| AcelRx Pharmaceuticals, Inc. | ACRX | Medical/Health/Life Science | 2011 |
| Achillion Pharmaceuticals, Inc. | ACHN | Medical/Health/Life Science | 2006 |
| Acme Packet, Inc. | APKT | Communications and Media | 2006 |
| Acorn International, Inc. | ATV | Communications and Media | 2007 |
| Actions Semiconductor Co., Ltd. | ACTS | Semiconductors/Other Elect | 2005 |
| Addus Homecare Corporation | ADUS | Medical/Health/Life Science | 2009 |
| Advanced Life Sciences Holdings, Inc. | ADLS | Medical/Health/Life Science | 2005 |
| Aegerion Pharmaceuticals, Inc. | AEGR | Medical/Health/Life Science | 2010 |
| AerCap Holdings N.V. | AER | Non-High-Technology | 2006 |
| Affymax Inc | AFFY | Biotechnology | 2006 |
| AGA Medical Corporation | AGAM | Medical/Health/Life Science | 2009 |
| Agria Corporation | GRO | Non-High-Technology | 2007 |
| Air Lease Corporation | AL | Non-High-Technology | 2011 |
| Aircastle, Ltd. | AYR | Non-High-Technology | 2006 |
| Alexza Pharmaceuticals, Inc. | ALXA | Medical/Health/Life Science | 2006 |
| Alimera Sciences, Inc. | ALIM | Biotechnology | 2010 |
| Allion Healthcare, Inc. | ALLI | Medical/Health/Life Science | 2005 |
| Alphatec Holdings Inc | ATEC | Medical/Health/Life Science | 2006 |
| Altra Holdings, Inc. | AIMC | Non-High-Technology | 2006 |
| American Public Education, Inc. | APEI | Computer Related | 2007 |
| Amicus Therapeutics, Inc. | FOLD | Biotechnology | 2007 |
| Amyris, Inc. | AMRS | Non-High-Technology | 2010 |
| Anacor Pharmaceuticals, Inc. | ANAC | Medical/Health/Life Science | 2010 |
| Animal Health Holdings Inc | AHII | Biotechnology | 2007 |
| Annie's, Inc. | BNNY | Non-High-Technology | 2012 |
| Anthera Pharmaceuticals, Inc. | ANTH | Medical/Health/Life Science | 2010 |
| Approach Oil and Gas Inc. | AREX | Non-High-Technology | 2007 |
| ARAMARK Corp | ARMK | Non-High-Technology | 2013 |
| Archipelago Learning LLC | ARCL | Computer Related | 2009 |
| Arcos Dorados, S.A. | ARCO | Non-High-Technology | 2011 |
| Artisan Partners, L.P. | APAM | Non-High-Technology | 2013 |
| ARYx Therapeutics, Inc. | ARYX | Biotechnology | 2007 |

| | | | |
|---|---|---|---|
| Aspreva Pharmaceuticals Corporation | ASPV | Medical/Health/Life Science | 2005 |
| ATA, Inc. | ATAI | Computer Related | 2008 |
| Athlon Energy LP | ATHL | Non-High-Technology | 2013 |
| AtriCure Inc | ATRC | Biotechnology | 2005 |
| AuthenTec, Inc. | AUTH | Semiconductors/Other Elect | 2007 |
| Avago Technologies, Ltd. | AVGO | Semiconductors/Other Elect | 2009 |
| Aventine Renewable Energy, Inc. | AVR | Non-High-Technology | 2006 |
| AVEO Pharmaceuticals, Inc. | AVEO | Medical/Health/Life Science | 2010 |
| Aviv REIT, Inc. | AVIV | Non-High-Technology | 2013 |
| AxoGen Inc | AXGN | Medical/Health/Life Science | 2013 |
| BankUnited Inc | BKU | Non-High-Technology | 2011 |
| Benefitfocus.Com Inc | BNFT | Computer Related | 2013 |
| Berry Plastics Corporation | BERY | Non-High-Technology | 2012 |
| BG Medicine, Inc. | BGMD | Biotechnology | 2011 |
| Bill Barrett Corp | BBG | Non-High-Technology | 2004 |
| Biodel, Inc. | BIOD | Medical/Health/Life Science | 2007 |
| BioMimetic Therapeutics, Inc. | BMTI | Biotechnology | 2006 |
| Blackbaud Inc | BLKB | Computer Related | 2004 |
| BlueLinx Holdings Inc | BXC | Non-High-Technology | 2004 |
| Booz Allen Hamilton Holding Corporation | BAH | Non-High-Technology | 2010 |
| Brookdale Senior Living Inc | BKD | Medical/Health/Life Science | 2005 |
| C&J Energy Services Inc | CJES | Non-High-Technology | 2011 |
| Cadence Pharmaceuticals, Inc. | CADX | Medical/Health/Life Science | 2006 |
| Caesars Entertainment Corporation | CZR | Non-High-Technology | 2012 |
| Camelot Information Systems, Inc. | CIS | Computer Related | 2010 |
| Capital Bank Financial Corporation | CBF | Non-High-Technology | 2012 |
| Carbonite, Inc. | CARB | Computer Related | 2011 |
| Cardica Inc | CRDC | Biotechnology | 2006 |
| Cardtronics, Inc. | CATM | Computer Related | 2007 |
| Cavium, Inc. | CAVM | Semiconductors/Other Elect | 2007 |
| Celanese Corp | CE | Non-High-Technology | 2005 |
| Cellu Tissue Holdings, Inc. | CLU | Non-High-Technology | 2010 |
| Chart Industries, Inc. | GTLS | Non-High-Technology | 2006 |
| Chesapeake Midstream Partners, L.P. | CHKM | Non-High-Technology | 2010 |
| China Finance Online Co., Ltd. | JRJC | Computer Related | 2004 |
| China GrenTech Corporation | GRRF | Semiconductors/Other Elect | 2006 |
| China Kanghui Holdings | KH | Biotechnology | 2010 |
| China Nepstar Chain Drugstore, Ltd. | NPD | Non-High-Technology | 2007 |
| China Nuokang Bio-Pharmaceutical, Inc. | NKBP | Biotechnology | 2009 |
| China Sunergy Co., Ltd. | CSUN | Semiconductors/Other Elect | 2007 |
| Chuy's Holdings, Inc. | CHUY | Non-High-Technology | 2012 |
| Cinemark Holdings, Inc. | CNK | Communications and Media | 2007 |
| Clayton Holdings LLC | CLAY | Non-High-Technology | 2006 |

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|---|---|---|---|
| Clean Energy Fuels Corp | CLNE | Non-High-Technology | 2007 |
| Clearwire Corporation | CLWR | Communications and Media | 2007 |
| Cleveland Biolabs, Inc. | CBLI | Biotechnology | 2006 |
| Clovis Oncology, Inc. | CLVS | Biotechnology | 2011 |
| Clubcorp Inc | MYCC | Non-High-Technology | 2013 |
| CNInsure Inc. | CISG | Non-High-Technology | 2007 |
| Cobalt International Energy, Inc. | CIE | Non-High-Technology | 2009 |
| Compellent Technologies, Inc. | CML | Computer Related | 2007 |
| Complete Production Services, Inc. | CPX | Non-High-Technology | 2006 |
| Comverge, Inc. | COMV | Computer Related | 2007 |
| Concord Medical Services Holdings, Ltd. | CCM | Medical/Health/Life Science | 2009 |
| Constant Contact, Inc. | CTCT | Computer Related | 2007 |
| Copano Energy LLC | CPNO | Non-High-Technology | 2004 |
| CoTherix, Inc. | CTRX | Biotechnology | 2004 |
| Coty US Inc | COTY | Non-High-Technology | 2013 |
| Country Style Cooking Restaurant Chain Co., Ltd. | CCSC | Non-High-Technology | 2010 |
| Criteo SA | CRTO | Communications and Media | 2013 |
| CTC Media, Inc. | CTCM | Communications and Media | 2006 |
| Cumberland Pharmaceuticals, Inc. | CPIX | Medical/Health/Life Science | 2009 |
| CVR Energy, Inc. | CVI | Non-High-Technology | 2007 |
| Data Domain, Inc. | DDUP | Computer Related | 2007 |
| Del Frisco's Restaurant Group, Inc. | DFRG | Non-High-Technology | 2012 |
| Demand Media, Inc. | DMD | Communications and Media | 2011 |
| Design Within Reach Inc | DWRI | Non-High-Technology | 2004 |
| Diamondback Energy, Inc. | FANG | Non-High-Technology | 2012 |
| Dice Holdings, Inc. | DHX | Non-High-Technology | 2007 |
| Digital Realty Trust, Inc. | DLR | Computer Related | 2004 |
| DivX, Inc. | DIVX | Computer Related | 2006 |
| Dollar Financial Group Inc | DLLR | Non-High-Technology | 2005 |
| Dollar General Corporation | DG | Non-High-Technology | 2009 |
| Doubleline LLC | DSL | Non-High-Technology | 2013 |
| Double-Take Software, Inc. | DBTK | Computer Related | 2006 |
| Dover Saddlery Inc | DOVR | Non-High-Technology | 2005 |
| DreamWorks Animation SKG, Inc. | DWA | Communications and Media | 2004 |
| Dresser-Rand, Inc. | DRC | Non-High-Technology | 2005 |
| Duff & Phelps Corp | DUF | Non-High-Technology | 2007 |
| Dunkin Brands Group, Inc. | DNKN | Non-High-Technology | 2011 |
| Dyncorp International Inc | DCP | Non-High-Technology | 2006 |
| Eagle Bulk Shipping, Inc. | EGLE | Non-High-Technology | 2005 |
| Eagle Rock Energy Partners LP | EROC | Non-High-Technology | 2006 |
| Educate Inc | EEEE | Non-High-Technology | 2004 |
| Ehealth Inc | EHTH | Medical/Health/Life Science | 2006 |
| eLong, Inc. | LONG | Computer Related | 2004 |
| Eloqua, Inc. | ELOQ | Computer Related | 2012 |

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|---|---|---|---|
| Emdeon Inc | EM | Medical/Health/Life Science | 2009 |
| Emergency Medical Services | EMS | Medical/Health/Life Science | 2005 |
| Endocyte, Inc. | ECYT | Biotechnology | 2011 |
| Endurance International Group Inc | EIGI | Computer Related | 2013 |
| Energy Transfer Equity LP | ETE | Non-High-Technology | 2006 |
| EnergySolutions Inc | ES | Non-High-Technology | 2007 |
| EnerNOC, Inc. | ENOC | Computer Related | 2007 |
| EnteroMedics, Inc. | ETRM | Medical/Health/Life Science | 2007 |
| EPAM Systems, Inc. | EPAM | Computer Related | 2012 |
| Epizyme Inc | EPZM | Biotechnology | 2013 |
| Erickson Air-Crane, Inc. | EAC | Non-High-Technology | 2012 |
| Eschelon Telecom, Inc. | ESCH | Communications and Media | 2005 |
| Eurand NV | EURX | Medical/Health/Life Science | 2007 |
| EV Energy Partners, L.P. | EVEP | Non-High-Technology | 2006 |
| ev3, Inc. | EVVV | Biotechnology | 2005 |
| EverBank Financial Corporation | EVER | Non-High-Technology | 2012 |
| Evertec Group LLC | EVTC | Computer Related | 2013 |
| ExactTarget Inc | ET | Computer Related | 2012 |
| ExlService Holdings, Inc. | EXLS | Computer Related | 2006 |
| Express, Inc. | EXPR | Non-High-Technology | 2010 |
| Fabrinet, Inc. | FN | Semiconductors/Other Elect | 2010 |
| Fairway Group Holdings Corporation | FWM | Non-High-Technology | 2013 |
| Fastclick, Inc. | FSTC | Communications and Media | 2005 |
| Fate Therapeutics Inc | FATE | Biotechnology | 2013 |
| Fidelity and Guaranty Life Insurance Company | FGL | Non-High-Technology | 2013 |
| Fidelity National Information Services Inc | FIS | Computer Related | 2006 |
| First Mercury Financial Corporation | FMR | Non-High-Technology | 2006 |
| First NBC Bank Holding Company | NBCB | Non-High-Technology | 2013 |
| Flagstone Reinsurance Holdings, S.A. | FSR | Non-High-Technology | 2007 |
| FleetCor Technologies, Inc. | FLT | Computer Related | 2010 |
| Fleetmatics Group PLC | FLTX | Computer Related | 2012 |
| Fluidigm Corporation | FLDM | Biotechnology | 2011 |
| Focus Media Holding Ltd | FMCN | Communications and Media | 2005 |
| Fortegra Financial Corp | FRF | Non-High-Technology | 2010 |
| Fortress Investment Group LLC | FIG | Non-High-Technology | 2007 |
| Fox Factory Inc | FOXF | Non-High-Technology | 2013 |
| Francesca's Collections, Inc. | FRAN | Non-High-Technology | 2011 |
| Freescale Semiconductor, Ltd. | FSL | Semiconductors/Other Elect | 2011 |
| FXCM, Inc. | FXCM | Non-High-Technology | 2010 |
| Generac Holdings, Inc. | GNRC | Non-High-Technology | 2010 |
| Genpact Ltd | G | Non-High-Technology | 2007 |
| GeoMet, Inc. | GMET | Non-High-Technology | 2006 |
| Gigamon LLC | GIMO | Communications and Media | 2013 |
| Global Brass and Copper, Inc. | BRSS | Non-High-Technology | 2013 |
| Global Cash Access Holdings, Inc. | GCA | Non-High-Technology | 2005 |

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|---|---|---|---|
| Global Education and Technology Group | GEDU | Non-High-Technology | 2010 |
| Glu Mobile, Inc. | GLUU | Computer Related | 2007 |
| GNC Corporation | GNC | Non-High-Technology | 2011 |
| Goodman Global, Inc. | GGL | Non-High-Technology | 2006 |
| Google, Inc. | GOOG | Computer Related | 2004 |
| Gordmans Stores, Inc. | GMAN | Non-High-Technology | 2010 |
| Groupon, Inc. | GRPN | Computer Related | 2011 |
| GSI Technology, Inc. | GSIT | Semiconductors/Other Elect | 2007 |
| Guidewire Software, Inc. | GWRE | Computer Related | 2012 |
| Gundle/SLT Environmental, Inc. | GSE | Non-High-Technology | 2012 |
| Hannon Armstrong Capital LLC | HASI | Non-High-Technology | 2013 |
| Hansen Medical, Inc. | HNSN | Medical/Health/Life Science | 2006 |
| HD Supply Holdings, Inc. | HDS | Non-High-Technology | 2013 |
| HealthSpring, Inc. | HS | Medical/Health/Life Science | 2006 |
| Herbalife Ltd | HLF | Non-High-Technology | 2004 |
| Heritage-Crystal Clean, Inc. | HCCI | Non-High-Technology | 2008 |
| hhgregg, Inc. | HGG | Non-High-Technology | 2007 |
| Hilton Worldwide Inc | HLT | Non-High-Technology | 2013 |
| Horizon Technology Finance Corporation | HRZN | Non-High-Technology | 2010 |
| Hyatt Hotels Corporation | H | Non-High-Technology | 2009 |
| ICx Technologies, Inc. | ICXT | Semiconductors/Other Elect | 2007 |
| Ideal Power Inc | IPWR | Non-High-Technology | 2013 |
| Ignite Restaurant Group, Inc. | IRG | Non-High-Technology | 2012 |
| Ikanos Communications, Inc. | IKAN | Semiconductors/Other Elect | 2005 |
| ImaRx Therapeutics, Inc. | IMRX | Biotechnology | 2007 |
| Imperva, Inc. | IMPV | Computer Related | 2011 |
| InnerWorkings, Inc. | INWK | Communications and Media | 2006 |
| Innophos Holdings Inc | IPHS | Non-High-Technology | 2006 |
| Intralinks Holdings, Inc. | IL | Computer Related | 2010 |
| Intrepid Potash, Inc. | IPI | Non-High-Technology | 2008 |
| iSoftStone Holdings, Ltd. | ISS | Computer Related | 2010 |
| J Crew Group Inc | JCG | Non-High-Technology | 2006 |
| J G Wentworth & Company Inc | JGW | Non-High-Technology | 2013 |
| Jackson-Hewitt, Inc. | JTX | Non-High-Technology | 2004 |
| Jazz Pharmaceuticals Inc | JAZZ | Medical/Health/Life Science | 2007 |
| JinkoSolar Holding Co., Ltd. | JKS | Semiconductors/Other Elect | 2010 |
| Jive Software, Inc. | JIVE | Computer Related | 2011 |
| K & F Industries, Inc. | KFI | Non-High-Technology | 2005 |
| Kanbay International Inc | KBAY | Computer Related | 2004 |
| KAR Auction Services | KAR | Non-High-Technology | 2009 |
| KayakCom | KYAK | Computer Related | 2012 |
| Kinder Morgan, Inc. | KMI | Non-High-Technology | 2011 |
| Kosmos Energy, Ltd. | KOS | Non-High-Technology | 2011 |
| Laredo Petroleum, Inc. | LPI | Non-High-Technology | 2011 |
| LeMaitre Vascular, Inc. | LMAT | Medical/Health/Life Science | 2006 |

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|---|---|---|---|
| LHC Group, Inc. | LHCG | Medical/Health/Life Science | 2005 |
| Limelight Networks, Inc. | LLNW | Communications and Media | 2007 |
| Lincoln Educational Services Corp | LINC | Non-High-Technology | 2005 |
| Liquidity Services, Inc. | LQDT | Non-High-Technology | 2006 |
| LogMeIn, Inc. | LOGM | Computer Related | 2009 |
| LoopNet, Inc. | LOOP | Computer Related | 2006 |
| LPL Financial LLC | LPLA | Non-High-Technology | 2010 |
| Lumber Liquidators Holdings, Inc. | LL | Non-High-Technology | 2007 |
| Luna Innovations, Inc. | LUNA | Semiconductors/Other Elect | 2006 |
| M/A-COM Technology Solutions, Inc. | MTSI | Semiconductors/Other Elect | 2012 |
| Maidenform Brands, Inc. | MFB | Non-High-Technology | 2005 |
| MAKO Surgical Corporation | MAKO | Medical/Health/Life Science | 2008 |
| Marketo Inc | MKTO | Computer Related | 2013 |
| Mattress Holding Corporation | MFRM | Non-High-Technology | 2011 |
| Mecox Lane, Ltd. | MCOX | Non-High-Technology | 2010 |
| MedGenics Inc | MDGN | Biotechnology | 2011 |
| MediaMind Technologies, Inc. | MDMD | Communications and Media | 2010 |
| Medidata Solutions, Inc. | MDSO | Computer Related | 2009 |
| Meru Networks, Inc. | MERU | Computer Related | 2010 |
| Metals USA Holdings Corporation | MUSA | Non-High-Technology | 2010 |
| Micrus Endovascular Corp | MEND | Biotechnology | 2005 |
| Midstates Petroleum Company, Inc. | MPO | Non-High-Technology | 2012 |
| Millennial Media, Inc. | MM | Communications and Media | 2012 |
| Mindray Medical International, Ltd. | MR | Medical/Health/Life Science | 2006 |
| MISTRAS Group, Inc. | MG | Semiconductors/Other Elect | 2009 |
| Molycorp, Inc. | MCP | Non-High-Technology | 2010 |
| Momenta Pharmaceuticals, Inc. | MNTA | Medical/Health/Life Science | 2004 |
| Montage Technology Co Ltd | MONT | Semiconductors/Other Elect | 2013 |
| Morningstar, Inc. | MORN | Non-High-Technology | 2005 |
| Motricity, Inc. | MOTR | Communications and Media | 2010 |
| MRC Global, Inc. | MRC | Non-High-Technology | 2012 |
| MYR Group, Inc. | MYRG | Non-High-Technology | 2008 |
| Nationstar Mortgage Holdings, Inc. | NSM | Non-High-Technology | 2012 |
| NeoPhotonics Corporation | NPTN | Semiconductors/Other Elect | 2011 |
| Ness Technologies Inc | NSTC | Computer Related | 2004 |
| NeurogesX, Inc. | NGSX | Biotechnology | 2007 |
| New Oriental Education & Technology Group Inc | EDU | Non-High-Technology | 2006 |
| New River Pharmaceuticals, Inc. | NRPH | Medical/Health/Life Science | 2004 |
| Newkirk Realty Trust, Inc. | NKT | Non-High-Technology | 2005 |
| NewStar Financial, Inc. | NEWS | Non-High-Technology | 2006 |
| Nextest Systems Corporation | NEXT | Semiconductors/Other Elect | 2006 |
| Nielsen Company, The | NLSN | Non-High-Technology | 2011 |

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|---|---|---|---|
| Ninetowns Internet Technology Group Co., Ltd. | NINE | Computer Related | 2004 |
| Niska Gas Storage | NKA | Non-High-Technology | 2010 |
| Noodles & Co | NDLS | Non-High-Technology | 2013 |
| Noranda Aluminum Holdings Corporation | NOR | Non-High-Technology | 2010 |
| NYMEX Holdings, Inc. | NMX | Non-High-Technology | 2006 |
| SemiLEDs Corporation | LEDS | Semiconductors/Other Elect | 2010 |
| ServiceNow, Inc. | NOW | Computer Related | 2012 |
| SKY-MOBI, Ltd. | MOBI | Computer Related | 2010 |
| Springleaf Financial Services Inc | LEAF | Non-High-Technology | 2013 |
| Sungy Mobile Ltd | GOMO | Computer Related | 2013 |
| Tableau Software LLC | DATA | Computer Related | 2013 |