Downward Sloping Demand Curves, the Supply of Shares, and the Collapse of Internet Stock Prices

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ABSTRACT

During five weeks over March and April 2000, internet stocks declined 58%. Almost $700 billion in capitalization was lost. This sudden collapse has been attributed to an increase in the supply of shares from lock-up expirations and equity offerings. In this paper, I show that internet stocks collapsed in this period regardless of whether their lock-ups expired or not. Furthermore, daily internet stock portfolio returns were almost unaffected by the number or dollar amount of lock-up expirations that day, or by the amount of stock offered in IPOs or SEOs.

Nasdaq stocks in general, and stocks related to the internet in particular, declined sharply in March and April 2000. An equal-weighted portfolio of all internet stocks lost over 58% between March 10th, 2000 and April 17th, 2000. There were sickening drops of 10.6% on April 3rd, 10.9% on April 12th, and 15.2% on April 14th. Over this period, the capitalizations of these stocks declined by over $698 billion.

In this paper, I examine whether the collapse of internet stock prices can be attributed to the rapid increase in the supply of shares in these companies. Lock-up expirations and follow-on offerings made billions of dollars worth of shares in internet stocks available to public investors near the internet market peak. A number of authors, including Cochrane (2002), Ofek and Richardson (2003), and Hong, Scheinkman, and Xiong (2005), observe that if the demand curves for these stocks were downward sloping, the sharp increase in the supply of shares could explain the collapse of internet stocks in early 2000.

There are three reasons why the demand curves for internet stocks might be downward sloping. First, the increase in the number of shares of internet stocks was so large that it could materially tilt the weightings in a typical investor's portfolio toward these riskier stocks. This seems unlikely. At their peak, internet stocks made up six percent of the capitalization of the U.S. equity markets, and a much smaller portion of all investments. Second, if investors had very diverse opinions of the value of internet stocks, a fall in shares prices and correspondingly higher expected returns would be required to entice investors with less favorable opinions to hold the additional shares. It was certainly true that investors had diverse opinions about internet stocks. There is also an implicit assumption here though that short-sales were constrained in some ways. With no short-sale constraints the views of the pessimistic investors would have been incorporated in stock prices even before the supply of shares was increased. Finally, Cochrane (2002) suggests that much of the demand for shares of internet stocks came from short-term speculators. These traders were willing to buy stocks with inflated prices and negative expected long-run returns in hopes of making short-term trading profits. Additional shares though, had to be held by long-term investors who required positive expected long-run returns, and hence lower prices.

The closer look at the data provided in this paper suggests however, that demand for

internet stock shares was sufficiently elastic so that the increase in the supply of shares in early 2000 was not responsible for the crash in internet stock prices. Regressions indicate that only a small proportion of monthly or daily returns of internet indices can be explained by the contemporaneous number of lock-up expirations or value of shares unlocked. Similarly, there appears to be little relation between the value of shares offered in IPOs and SEOs and the contemporaneous returns of internet indices. An increase in the supply of shares does not seem to explain the collapse of individual internet stock prices either. During the meltdown of internet stocks in March and April 2000, stocks with lock-up provisions in effect, and hence a fixed supply of shares, performed worse than stocks with expired lock-up provisions and potentially increasing public floats.

I do find that an increase in the supply of shares does have an impact on prices of individual internet stocks. In my sample, individual internet stocks with lock-up expirations earn market adjusted returns of -7.3% in the six days ending on the lock-up expiration. The collapse of internet stock prices, however, was too large and included too many stocks to be explained by changes in the supply of shares.

Finding out why internet stock prices collapsed is interesting in and of itself, but it can also shed light on why the prices were so high in the first place. If internet stocks crashed when supply increased, it suggests that a limited supply of shares was partly responsible for high prices. My findings, which suggest that the internet stock crash was not caused by an increase in publicly available shares, also indirectly suggest that the high prices of internet stocks were not due to restricted supply.

The rest of the paper is organized as follows. I provide a brief survey of the literature on downward sloping demand curves for stocks in Section I. The sample used in this paper is described in Section II. Section III reports the results on how internet stock prices were affected by increases in the supply of shares. Section IV offers a summary of the paper and draws conclusions.

I. Downward Sloping Demand Curves for Shares

There is evidence from several sources that demand curves for shares are downward sloping. One source of clean tests of demand elasticity is additions to stock indices. Inclusion in an index does not provide any information about the company's prospects. In fact, Standard and Poors' press releases for index changes explicitly state that they do not "in any way reflect an opinion on the investment merits of the company." At the same time, inclusion in an index means that passive index investors will purchase shares of the stock, in effect permanently withdrawing some of the shares from trading. Harris and Gurel (1986), Shleifer (1986), Lynch and Mendenhall (1997), Wurgler and Zhuravskaya (2002), and others document significant abnormal returns of around 3% when stocks are added to the S&P 500. Likewise, stocks earn significant negative abnormal returns around removal from the S&P 500. Similar results are reported for stocks that are added to or deleted from foreign indices. Chakrabarti, Huang, Jayaraman, and Lee (2002) examine additions to and deletions from the Morgan Stanley Capital International (MSCI) indices for 29 countries. They find an average cumulative abnormal return of 5.3% over the approximately one month from the announcement of the index change until ten days after.

Dutch auction repurchases allow direct estimation of the elasticity of demand for shares in a stock. In a Dutch auction, shareholders are invited to submit offers to sell their shares at a reservation price that they specify. The firm then repurchases stock at the lowest price that allows them to buy the desired number of shares. Investors who tendered shares at or below that price will have their shares repurchased. Bagwell (1992) examines 32 Dutch auction share repurchases. She finds that the average difference between the 1st percentile bid and the 16th percentile bid is 9.1%, implying that firms need to pay a premium of 9.1% to repurchase 15% of their stock. This premium implies an average elasticity of demand of 1.65. Estimates obtained by regressing price on quantity for individual stocks produces an average elasticity of 0.68 and a median elasticity of 1.05. These elasticities of supply faced by the repurchasing companies can be thought of as the negative of the elasticity of demand of the investors.

Returns around the expirations of IPO lock-up provisions also provide evidence that

demand curves for shares are downward sloping. When a firm goes public, insiders usually agree to hold, or lock-up their shares for a set period of time. In about 90% of IPOs the lock-up period lasts for six months from the offering date. As soon as the lock-up expires, insiders are free to sell shares subject to some limitations on the amount to be sold at a particular time. Lock-up expiration dates are widely known in advance, and hence selling at the expiration isn't new information.

Despite this, stock prices decline when lock-ups expire. Field and Hanka (2001) examine 1,948 lock-up expirations that occurred from 1988 through 1997. On average, stocks experience a three-day return of -1.5% around expirations, with larger declines for firms with venture capital backing. Cross-sectional tests conducted by Fields and Hanka suggest that downward-sloping demand curves for shares explain part, but not all, of the price declines. Ofek and Richardson (2000) study lock-up expirations for 1,056 IPOs over 1996-1998. They find cumulative abnormal returns of -2.03% for the five day period ending with the lock-up expiration. The consistency of the results across the three years of their sample period convince Ofek and Richardson that the price decline cannot be the result of greater than expected selling. Like Fields and Hanka, they conclude that downward sloping demand curves are the most likely explanation for the negative returns around IPO lock-up expirations. They add that it is unlikely that investors can profit from this after incorporating trading costs.

Given the evidence for downward sloping demand curves for shares, it is easy to see why many observers believe that an increase in the supply of publicly available shares brought about the collapse of internet stock prices. The peak of internet stock valuations coincided with large number of lock-up expirations that significantly increased in the amount of internet stock available to the public. I document this using an equally weighted index of all internet stocks that went public between January 1996 and December 2000. Figure 1a shows cumulative raw returns for this index and the number of lock-up expirations for these stocks for each month from August 1996 through March of 2001. To obtain cumulative returns, I take an equal-weighted average of the returns on sample stocks each day. Returns are then compounded over the period, with end-of-month cumulative returns shown in the figure. Internet stocks returned about 950% between September 1998 and February 2000. But as Figure 1a shows, the value of internet stocks peaked

at the same time that a large number of lock-up expirations occurred in late 1999 through 2000. Figure 1a also shows that prices of internet stocks fell abruptly in early 2000, and lost most of their value in three months.

Figure 1b graphs the cumulative returns of internet stocks and the total dollar value of unlocked shares of internet stocks. Following Fields and Hanka (2001), the value of unlocked shares on a given date is estimated by multiplying the price of the stock by the number of outstanding shares not sold in the IPO. Here, the relationship between lock-up expirations and the level of internet prices is even clearer. The dollar value of unlocked shares was very low in every month before 1999, and was much higher in late 1999 and early 2000 than at any other time. The dollar values on unlocked shares was large by any standard. In January 2000, over $70 billion worth of shares were unlocked. For the four months from December 1999 through March 2000, more than $200 billion in internet shares were unlocked. Of course, insiders did not sell all of these shares at once. Nevertheless, we can expect a large increase in the supply of shares following lockup expirations.

Another source of supply of publicly available shares in internet stocks was shares offered to the public through IPOs and SEOs. Figure 1c shows the proceeds from offerings of internet stocks for the months of August 1996 through March 2001 along with the stocks' cumulative returns. This graph reveals large increases in the supply of internet stock to the public from equity offerings just before the collapse of internet stocks, a fact also noted by Cochrane (2002). Over April 1999 through April 2000, $53.6 billion worth of internet stock was sold to the public. The amount raised though equity sales peaked at $9.7 billion in February 2000, just before the market for internet stocks peaked.

These graphs are consistent with the assertion of several prominent economists that the increase in the supply of shares was behind the collapse of internet stock prices. In the view of Ofek and Richardson (2003) , the rapid rise in internet stock prices from mid - 1998 through February of 2000 occurred because investors had diverse views of the internet sector, there was a limited supply of shares, and short-sale constraints prevented the beliefs of pessimistic investors from being incorporated in stock prices. Shares were in short supply and hard to borrow because most internet stocks had gone public shortly before and most of their outstanding shares were

locked up. According to Ofek and Richardson the collapse of internet stock prices occurred as these stocks were released from lock-up restrictions, greatly increasing the number of shares available to the public and simultaneously making it easier for short-sellers to borrow shares.

Ofek and Richardson (2003) present a number of additional stylized facts that are consistent with their hypothesis. The value of internet shares unlocked in December 1999 and January 2000 exceeded the total value unlocked since 1997. The total value of internet shares sold to the public through insider sales, IPOs, and SEOs was greater in the five months from October 1999 though February 2000, than in the 21 months from January 1998 through September 1999. These facts are also documented in Figures 1a through 1c of this paper. Ofek and Richardson also observe that short interest, as a percentage of outstanding shares, increased significantly for their sample of internet stocks following lock-up expirations. Finally, the number of insider selling transactions in 2000 exceeded the total for 1998 and 1999.

Cochrane (2002) presents a similar perspective on the internet bubble, but with a novel and significant twist. He stresses that much of the demand for internet stocks came from short-term traders rather than long-term investors. With a high demand for these stocks and few available shares, short-term traders willingly paid more than the intrinsic value for the stock. They expected to turn over the shares and reap trading profits after only a few days, and were therefore willing to hold stocks with long-run negative expected returns. Cochrane's convenience yield theory implies that internet stock prices dropped as additional shares became available and long-term investors, who required positive long-run returns, were needed to hold the additional float.

Hong, Scheinkman, and Xiong (2005) consider how a small supply of shares and short-sale restrictions can cause stock prices to exceed fundamental values, and how lock-up expirations can bring prices back into line. In their model, investors are overconfident in the value of their private signals and there are constraints on short-selling. Under these circumstances, shares are held by the investors with the most optimistic signals of firm value. When lock-up provisions expire and additional shares come on the market, stock prices will fall for three reasons. First, risk-averse investors who are optimistic about the stock and hold shares will require a higher rate of return to purchase more shares. If enough shares come on the market,

prices will fall to the point where less optimistic investors will be enticed to hold the shares. Second, different private signals of value over time hold out the promise in their model that the currently optimistic investors will be able to sell out in the future to different investors who are even more optimistic. Additional shares outstanding decreases the value of this option to sell to greater fools as future optimistic investors will not pay as much per share when there are additional shares outstanding. Finally, according to Hong, Scheinkman, and Xiong, overconfident investors are sure that insiders have the same beliefs about the firm value as they do. When lockup periods expire, the currently optimistic shareholders expect insiders to hold on to their shares. But, the investors are overconfident and are inevitably disappointed. In this model all of these factors; downward sloping demand curves of risk-averse investors, the reduced value of the option to sell shares to greater fools, and the inevitable disappointment as insiders sell more shares than expected, lead to a fall in prices at lock-up expirations.

II. Sample

To obtain my sample of internet stocks, I start with every U.S. IPO issued between January 1996 and December 2000. These IPOs are then checked against the list of internet stock IPOs maintained by Jay Ritter on his website, http://bear.cba.ufl.edu/ritter/. Stocks classified as internet IPOs by Ritter are kept in the sample, as well as a handful of additional IPOs that are described in their prospectuses as internet businesses. Lock-up expiration dates are obtained from Securities Data Corporation (SDC). If missing on SDC, lock-up provisions are obtained from the prospectus. Finally, sample stocks are checked against the CRSP tapes. If the first date of returns on the CRSP date differs from the SDC offering date by more than 20 days, the IPO is omitted from the sample. The final sample includes 456 IPOs.

Table I provides some sample characteristics. Of the 456 stocks that appear in the sample, 446 list on Nasdaq. The median percentage of shares issued in the IPO is 18.2%, while the mean proportion is 20.6%. Following Fields and Hanka (2001), I approximate the value of shares unlocked by multiplying the firm capitalization on the lock-up expiration date by the proportion of shares not issued in the IPO. The median value of shares unlocked for the sample firms is $293 million, while the mean value is just over $1 billion. Table I provides mean daily returns

and turnover for four periods. During the runup period, from July 1, 1998 through the peak on March 10, 2000, the average daily return of internet stocks was 0.528% while the mean daily turnover was 3.048%. This turnover figure lends credence to Cochrane's convenience yield theory. Most Nasdaq trading was taking place on ECN's during this period, so, as an approximation, we can ignore double counting of volume and say that 3% of shares outstanding changed hands every day for internet stocks. Only about 20% of outstanding shares were issued in IPOs though, so about 15% of the public float traded every day. Put another way, shares in public hands were held for an average of seven trading days before being resold.

Of particular interest in Table I are what I refer to as the expanded crash period from March 13, 2000 through April 17, 2000 and the crash period from April 10, 2000 through April 14, 2000. Over the more than one month that constitutes the expanded crash period, internet stocks had average daily returns of -3.18%. For the five day crash period, returns of internet stocks averaged -8.90% per day and losses exceeded 5% each day. It is interesting that turnover was not particularly high during either the crash period or the expanded crash period.

III. Changes in the Supply of Shares and Internet Stock Returns

A. Lock-up Expirations and Stock Returns

Lock-up expirations have been explicitly mentioned by several researchers as a source of the increase in the supply of shares that brought about the collapse of internet stocks. The reasons for the emphasis on lock-up expirations are clear. They had the potential to increase the supply of shares far more than offerings of additional shares or easing of short-sale constraints. In addition, they were concentrated near the internet stock market peak.

I first verify previous papers' findings of negative abnormal returns around lock-up expirations for my sample of internet IPOs. Lock-up expiration dates are obtained from SDC or from offering prospectuses for 447 of the sample stocks. Short trading histories for most of the stocks make it difficult to estimate individual stock betas, so I calculate market-adjusted abnormal returns around the lock-up expiration. I use two different measures of expected returns

- the contemporaneous return on the CRSP equal-weighted index and the equal-weighted average return on all sample internet stocks on that day. Results are shown in Table II.

As in other studies, I find negative excess returns around lock-up expirations. In the case of internet stocks though, performance around lock-up expirations is particularly bad. When the CRSP equal-weighted index is used as a benchmark, the lock-up expiration date excess return is -1.88%, with a t-statistic of -4.24. The sum of the excess returns over the six days ending on the expiration date is -6.85%[1]. When the average return of sample internet stocks is used as a benchmark, the mean excess return is -1.57% on the expiration date and the sum of the excess returns for the six days ending on the expiration day is -5.94%. These results are similar to the findings of Ofek and Richardson (2003). For the 305 internet stocks in their sample the average excess return in the five days up to and including the lock-up expirations is -4.11%.

There are two reasons why performance may be poor in the days leading up to the lock-up expiration as well as on the expiration date itself. First, the lock-ups are agreements between shareholders of the company that is going public and the underwriters, and underwriters can release shareholders from their lock-up restrictions early. Releasing shareholders a few days early could result in negative returns before the expiration date. Second, in some cases there is ambiguity about the actual expiration date. As an example, for one of the IPOs a lock-up was said to be in effect for 180 days in one place in the prospectus, and for six months in another place in the same prospectus. In other cases, it was unclear whether the expiration occurred *in* 180 days, or *after* 180 days. In these cases, I use the later date as the expiration date.

B. Does a Large Number of Lock-up Expirations Explain the Crash of Internet Stocks?

If lock-ups expired for a large number of internet stocks around the same time, it is possible that including the performance of these stocks in an internet portfolio could drag down the measured performance of the entire internet sector. To test for this, I examine the expanded

[1]Market-adjusted returns are not significantly different from zero for days -9 through -6. I also try calculating excess returns by subtracting 2.5 times the market return from the internet return to incorporate the high betas estimated for the portfolio of internet stocks. Results are similar but excess returns are about 80 basis points lower over the six day period.

crash period from March 13, 2000 through April 17, 2000. Recall that during this period, internet stocks averaged losses of more than 3% per day. I divide sample stocks each day into three portfolios: stocks with expired lock-up periods, stocks with currently expiring lock-up periods, and stocks in which the lock-up period was still in effect. Stocks are defined as having currently expiring lock-ups if the lock-up expiration is no more than five days in the future and no more than 65 days past. This allows me to include the entire period of negative excess returns before the official expiration date and up to three months after. The lock-up period is defined as expired on a date if it is at least 66 days (roughly three months) after the expiration date. Stocks are classified as having a lock-up in effect if there is at least six days until the expiration date. Mean returns are calculated for each of the three portfolios for each day during the expanded crash period. T-tests for differences in means across the portfolios are calculated based on the cross-sectional standard deviations of returns within the portfolios.

Results are shown in Panel A of Table III. Differences in returns across the three categories of stocks are minimal. If lock-up expirations were behind the crash in internet stock prices, we would expect stocks with lock-ups still in effect to perform best. Over the entire expanded crash period though, the cumulative return on stocks with lock-ups in effect is -61.38%, lower than the cumulative return of -60.83% for stocks with currently expiring lock-ups and lower than the -54.09% for stocks with expired lockups. There is no single day over the period on which stocks with lock-ups in effect outperform stocks with expiring lock-ups by a statistically significant amount. So, the stocks with a fixed supply of shares underperformed those stocks that could expect an increase in float from insider sales. This is exactly the opposite of what we would expect if an increase in the supply of shares coupled with downward sloping demand curves were responsible for the collapse of internet stock prices.

Stocks with currently expiring lock-ups do underperform stocks with expired lock-ups by a statistically significant amount on a few individual days and over the entire period. But, the stocks with expired lock-ups do lose 54.09% over the period, again making it difficult to argue that the collapse of internet stock prices was due to lock-up expirations.

It is possible that a stock's lock-up expiration date could proxy for the firm's type of business, and that differences in business types could obscure differences in returns between

firms with expired lock-ups and lock-ups still in effect. Internet Service Providers (ISPs) for example, went public relatively early in the sample period while most internet security companies went public toward the end of the sample period. To account for this possibility, I obtain internetnews.com's classifications of internet stocks. They divide them into 13 categories: 1) content/communities, 2) e-tailers, 3) financial services, 4) ecommerce enablers, 5) security, 6) performance software, 7) internet services, 8) advertising/marketing, 9) consultants/designers, 10)speed/bandwidth, 11) ISPs/Access Providers, 12) wireless products and services, and 13) search/portals. I categorize each sample IPO using its internetnews.com sector. I use descriptions of the companies' businesses from their IPO prospectuses to classify stocks that no longer traded when internetnews.com made its list in 2002.

For each day during the expanded crash period I run a cross-sectional regression of stock returns on dummy variables for internet sector classifications and dummy variables for whether lock-up provisions were expired, or were still in effect. Results are shown in Table III Panel B.

I use F-tests for each daily regression and for the cross-sectional regression of cumulative returns to see if the sector dummy variables explain a significant portion of the variation in stock returns. For cumulative returns the p-value for the sector dummies' contribution is 0.0011. Hence there were significant differences in performance across internet sectors. The p-value is less than 1% in eight of the 26 daily regressions. Inclusion of these sector dummies has little impact however on how lock-up expirations affect returns. Over the entire period, after adjustment for sector, the cumulative returns for the portfolio of stocks with lock-ups in effect is 0.65% lower than the cumulative return for the portfolio of stock with currently expiring lock-ups. So, as before, stocks with lock-ups in effect underperformed those that had expiring lock-ups. Cumulative returns are 5.89% greater for stocks with expired lock-ups than stock with currently expiring lock-ups. Results for individual days are also similar to those in Panel A

As a whole, Table III shows that all internet stocks crashed in March and April 2000 regardless of whether their lock-up provisions were expiring, had already expired, or had not expired. Given these results it is difficult to argue that individual stocks crashed as their lock-ups expired and the large numbers of individual stocks with expiring lock-ups made the entire industry crash.

C. Lock-up Expirations When Internet Stocks are Close Substitutes

Alternatively, it is possible that internet stocks are sufficiently close substitutes that, with downward-sloping demand curves for shares, a lock-up expiration in some stocks led to price declines in internet stocks generally. Greenwood (2004) considers how uninformed demand changes affect prices of securities and their close substitutes. If there is a large exogenous increase in the demand for shares in a security, arbitraguers will supply the stock by going short. They will only do so if the expected return on their short positions is high enough to compensate them for their risk. This means that in the short run, the price must increase above its long-run value while the arbitrageurs are selling short. In the longer run, the price is expected to fall allowing the arbitrageurs to close out their short positions at a profit. Similarly, an uninformed decrease in demand for shares reduces a security's price to induce arbitrageurs to buy up the newly sold shares. The arbitrageurs will attempt to reduce their risk with offsetting positions in highly correlated securities. The result of this is that when a stock experiences an uninformed increase in demand, prices of correlated securities also increase. When there is an uninformed decrease in demand for shares in a company, prices of highly correlated stocks also fall.

Greenwood (2004) tests his model using a unique event. In April 2004, the Nikkei 225 index was re-weighted. Thirty new stocks were added to the index, 30 were deleted from the index, and the weights of the remaining 195 stocks were reduced. In the one week between the announcement of the re-weighting and its initiation, the additions to the index had an average return of 19%, while the deletions had an average return of -32% and the remaining 195 stocks had a mean return of -13%. These returns were essentially reversed over the following ten weeks. Of more interest though is the returns of stocks that were not added to or deleted from the index. If a stock was strongly positively correlated with stocks that were added to the index, its return was also positive when the index was re-weighted. If a stock's returns were strongly positively correlated with stocks that were deleted from the index, that stock also had negative returns when the index was re-weighted.

Greenwood's model and empirical findings have clear implications for the meltdown of internet stocks. If arbitraguers bought large positions in stocks with expiring lock-ups, they would hedge by going short or closing out long positions in highly correlated stocks. This could

bring about large price declines throughout the internet sector, even if most internet stocks were not directly affected by lock-up expirations. To test this, I first examine whether returns for the entire sample of internet stocks during a month are related to the number of stocks with lock-up expirations during that month. Figure 2a graphs the number of stocks with lock-up expirations during a month against the monthly return of the equal-weighted portfolio of all sample internet stocks for the 56 months from August 1996 through March 2001. The relation between returns and the number of contemporaneous lock-up expirations appears to be weak or non-existent. When I regress the monthly return on the number of lock-up expirations during the month, the coefficient is -0.0010 with a robust t-statistic of -0.38.

Figure 2b replicates 2a but graphs returns against the total dollar value of shares unlocked during the month. Here again there appears to be little relation between the value of shares unlocked and the monthly return of the portfolio of internet stocks. When I regress returns on the value of shares unlocked, the estimated coefficient is -0.00066 with a robust t-statistic of -0.44. If the natural log of the value of shares unlocked is used instead for the explanatory variable, the t-statistic remains an insignificant -0.82. So, there is no evidence that returns for internet stocks were lower during months when there were large numbers of internet stocks with lock-up expirations, or when large dollar values of shares became unlocked.

As an alternative, I use daily returns of the CRSP equal-weighted index of Nasdaq and NYSE/Amex stocks along with the number of lock-up expirations and the dollar value of unlocked shares to explain daily returns of the equal-weighted portfolio of internet stocks. Regressions are estimated for four different periods. The first is the entire sample period. The second, from July 1, 1998 through December 31, 1999, provides estimates of the impact of lock-up expirations on internet stock returns before the bubble burst. The third period, extends from July 1, 1998 through December 31, 2001. Regression estimates from this period include most of the runup in stock prices before the internet stock peak, the internet crash, and the period of decline that followed. Finally, the fourth period covers the year 2000. This includes the internet stock crash, but omits most of the runup in prices. Table II shows that Individual stock returns are negative not only on the lock-up expiration date, but on the five days leading up to it as well. Hence I include as explanatory variables the number of lock-up expirations and the dollar value of

shares unlocked on the six days ending on the expiration date.

Results are reported in Table IV. Panel A reports the regression estimates. In each of the regressions, the return on the CRSP equal-weighted portfolio is highly significant. The beta of the internet stock portfolio is very high, ranging from 2.41 for the entire period to 2.66 for the year 2000. The coefficient on the number of lock-up expirations that day is positive and insignificant in each of the four regressions. The coefficient on the number of expirations over the six days ending on the expirations date is negative in all periods. It is significant at the 5% level for the entire period and the period from July 1, 1998 through December 31, 2001. The largest coefficient in absolute value is -0.000731. This indicates that ten lock-up expirations in the past six days will reduce returns by 73 basis points. Results are generally weaker when the dollar value of shares unlocked is used instead of number of lock-up expirations. The coefficient on the dollar value of shares unlocked that day is never significant. The coefficient on the dollar value of shares unlocked that day and the next five days is only significant in the July 1, 1998 through December 31, 2001 period. It is interesting that 89% of the variation in the daily returns of the internet stock portfolio in 2000 can be explained by market returns. This suggests that the run-up in prices and the collapse of internet stocks in 2000 are the results of larger market-wide moves.

Several other variations on these regressions were tried but are not reported. Results are weaker when the CRSP value-weighted index is used or when the natural logarithm of the dollar value of unlocked shares is used. When the regressions are estimated using only the March 13, 2000 through April 17, 2000 expanded crash period, coefficients are insignificant but suggest that returns are *higher* on days with a large number of lock-up expirations.

In Panel B of Table IV, I plug the market return, the number of stocks with lock-up expirations, and the dollar value of shares unlocked during the expanded crash period into the regression estimates to examine the impact of expirations on internet stock returns during the crash. In the second column I use coefficients estimated over July 1, 1998 through December 31, 2001. The estimated impact of expirations on stock returns is highest in the regressions for this period, so using these coefficients maximizes the impact of lock-up expirations on returns. The total return on internet stocks over the expanded crash period was -58.16%. But, the market as a whole also declined over that time, and, with the high beta estimated for the internet portfolio, the

estimated loss due to market-wide factors was 42.27%. Using the coefficient from the regression that included the number of lock-up expirations implies that internet stocks lost 13.29% during the crash period as a result of lock-up expirations. When dollar value of shares unlocked is used instead, only 8.23% of the decline can be attributed to lock-up expirations. So, while it appears that a portion of the decline in internet stocks during the crash can be attributed to lock-up expirations, the market wide decline in stock prices explains a much larger proportion of internet stock returns during the crash.

Even the small portion of the internet crash that is attributed to lock-up expirations may be overstated. The impact of market returns and lock-up expirations is re-estimated using coefficients from the out-of-sample regressions that include July, 1998 through December, 1999. Now, 41.53% of the 58.16% decline in internet stock prices can be attributed to the market return. Only 6.75% can be attributed to the number of lock-up expirations. When the dollar value of shares unlocked is used instead of the number of lock-up expirations, it actually predicts a slightly positive return for internet stocks over the crash period.

To summarize, the meltdown of internet stocks was not accompanied by many contemporaneous lock-up expirations. The collapse of internet stocks seems better explained by the overall decline in the market and the great sensitivity of the internet sector to market-wide returns.

D. Equity Offerings and the Internet Stock Crash

Lock-up expirations were the largest source of new, publicly tradeable shares of internet stocks in 2000, but IPOs and SEOs also increased the supply of shares in public hands. If the demand curves for internet stock shares were downward sloping, and if they were close substitutes, it is possible that a large number of new equity offerings could depress the prices of the entire internet sector. To test this, I regress the daily returns of the equal-weighted portfolio of internet stocks on the number of offerings that day, the dollar value of the offerings (in billions), and the natural logarithm of the proceeds of the total amount raised in the offerings. I estimate these regressions separately from the lock-up expiration regressions because the dollar amounts are not really comparable. If $100 million worth of stock is unlocked on a day, it means that $100

million worth of stock can be sold in the future. If $100 million worth of stock is sold in an SEO, it means $100 million worth of new stock enters the public float that day.

The time series regression estimates are reported in Table V. I report regression estimates for two periods: February, 1996 through December, 2000, and January, 1999 through December, 2000. Results are the very similar when regressions are estimated of 1998-1999 and over just 2000. I do not include 2001, because there were almost no equity offerings by internet firms that year. In each case, regardless of whether I use the number of equity offerings, the dollar value of the offerings, or the log of the dollar value of the offerings, the coefficient on the equity offering variable is insignificant. Equity offerings do not seem to depress internet stock prices. In fact, if the regressions are estimated over the expanded crash period of March 13, 2000 through April 17, 2000, the coefficients on the equity offering variables are positive but insignificant. If anything, more offerings were associated with *higher* returns during the crash.[2]

E. Short-sale Restrictions and Internet Stock Prices

Most of the models that rely on an increase in the supply of shares to explain the internet crash explicitly or implicitly assume that the supply of shares was limited by restrictions on short-selling. In these models, limitations on short-selling prevented pessimistic investors' views from being incorporated in prices. It was only when additional shares were issued and new shareholders were needed to purchase internet stocks, that pessimistic views of the internet sector were incorporated in prices. In addition, Ofek and Richardson (2003) propose that short-sale restrictions were eased by the increase in loanable shares at the expiration of lock-up provisions. So, not only did lock-up expirations increase the public supply of shares directly, they also allowed the supply to increase indirectly through short-sales by pessimistic investors.

It is true that many internet stocks were hard to borrow in 1999 and 2000. But, Battalio and Schultz (2005) show that synthetic shorts that tracked the internet sector as a whole could have been constructed cheaply using options. To see if an easing of short-sale restrictions led to price declines in individual stocks in early 2000, I obtain from Nasdaq monthly short interest, or

[2]When offerings over the past six days are included in the regression, both the number of offerings over six days and the number the same day are insignificant.

the total number of shares sold short, for all internet stocks for 1999 and 2000. As shown in Table I, almost all internet stocks traded on Nasdaq, so the short-interest data can be considered complete for the internet sector. Short interest is reported to the NASD by member firms on the 15th of each month, or the preceding business day if the 15th is not a business day. The settlement period in 1999 and 2000 was three days, hence the short interest reported on the 15th includes all the short-sales that took place at least three business days before. I therefore calculate returns for each stock for months ending three business days before the 15th of each calendar month.

Short-interest itself is not sufficient to indicate whether stocks are easy or hard to borrow. If an easing of short-sale restrictions led to a collapse of prices of individual stocks though, we should see price declines accompanied by increases in short interest for the stocks. To examine this, I perform cross-sectional regressions of returns on internet stocks on changes in the short interest, expressed as a percentage of shares outstanding, for each month from July 1999 through June 2000. The results are reported in Table VII. Short-interest is not significant in any of the 12 regressions. For the month ending with the reporting of short interest on April 12, 2000, the intercept is -0.401, indicating that an internet stock with no change in short-interest would be expected to fall by 40%. The coefficient on the change in short interest is insignificant with a t-statistic of -0.58.

There is no evidence in Table VII that changes in short-sale restrictions had any part in the collapse of internet stocks. This suggests that inability to sell short was not a major factor in the high prices of internet stocks before their collapse.

IV. Summary and Conclusions

After generating returns of over 2200% in less than four years, Internet stock prices peaked in March 2000. They then lost almost $700 billion in market capitalization over the next five weeks, culminating in a return of -37.5% for the week of April 10th through April 14th 2000. Most of the outstanding shares of internet stocks were locked up in 1999 and early 2000, leaving only a small supply of shares available to the public. The stock price peak coincided with a large supply of shares of internet stocks being made available to the public through lock-up expirations and equity offerings. This has lead several observers to suggest that the collapse of internet stock

prices was caused by the increase in the supply of shares.

The results of this paper suggest that increases in the public float of internet stocks did not bring about the collapse of share prices. When the market for internet stocks collapsed, the stocks that were restricted to a fixed supply of shares by lock-up provisions actually performed worse than stocks with an increasing supply of shares. If we assume that internet stocks are good substitutes for each other, all internet stock prices should be affected by the increased supply of shares of some of the stocks. But, in time series regressions, I find that the performance of an equal-weighted portfolio of Internet stocks was almost unaffected by the number contemporaneous lock-up expirations. Likewise, the performance of the equal-weighted portfolio of internet stocks was not significantly affected by either the number of contemporaneous equity offerings, or the dollar value of the offerings.

This may also say something about why internet stock prices were so high in the first place. If stock prices collapsed because new shares became available to the public, we can say that the high prices of internet stocks in 1999 and early 2000 were the result of a small supply of shares. On the other hand, the conclusion of this paper that the collapse of prices was not brought about by an increase in the supply of shares suggests that prices of internet stocks were high for other, more fundamental reasons.

Table I.
Sample Characteristics

The sample of internet stocks includes all companies that went public in the U.S. from 1/1/1996 through 12/31/2000 that Jay Ritter's website, http://bear.cba.ufl.edu/ritter/, lists as internet stocks. A handful of additional stocks that are described as internet stocks in their IPO prospectus are also included. For each stock, the value of shares unlocked is approximated by multiplying the firm capitalization on the lock-up expiration date by the proportion of shares not issued in the IPO. Daily returns and turnovers are averaged across all stocks with available returns each day. Mean returns and turnovers for various periods are obtained by averaging the daily means.

Number of Internet Stocks	456
Number on Nasdaq	446
Median Percent Shares Issued in IPO	18.2%
Mean Percent Shares Issued in IPO	20.6%
Median Value of Shares Unlocked	$293 million
Mean Value of Shares Unlocked	$1,060 million
Mean Daily Return 7/1/1998 Until Peak	0.528%
Mean Daily Turnover 7/1/1998 Until Peak	3.048%
Mean Daily Return Peak Until 12/31/2001	-0.232%
Mean Daily Turnover Peak Until 12/31/2001	1.120%
Mean Daily Return 3/13/2000 to 4/17/2000	-3.178%
Mean Daily Turnover 3/13/2000 to 4/17/2000	1.784%
Mean Daily Return 4/10/2000 to 4/14/2000	-8.903%
Mean Daily Turnover 4/10/2000 to 4/14/2000	1.808%

Table II.
Excess Returns Around Lock-up Expirations

Excess returns are calculated as the difference between the stocks return and either the CRSP equal-weighted return or an average return of all internet stocks that day. T-statistics are based on the cross-sectional standard deviation of excess returns for that day. The number of observations across the eleven day event window ranges from 445 to 447 for excess returns based on the CRSP index, and from 444 to 446 for returns based on the average return of internet stocks.

Event Date	Excess Return Using the CRSP Equal-Weighted Index	Excess Return Using an Equal-Weighted Average Return of Internet Stocks
-5	-0.0113	-0.0085
	(-2.80)	(-2.33)
-4	-0.0112	-0.0091
	(-2.76)	(-2.27)
-3	-0.0066	-0.0061
	(-1.76)	(-1.71)
-2	-0.0076	-0.0076
	(-2.13)	(-2.20)
-1	-0.0130	-0.0124
	(-3.23)	(-3.29)
0	-0.0188	-0.0157
	(-4.24)	(-3.62)
1	-0.0028	-0.0010
	(-0.61)	(-0.24)
2	-0.0002	0.0008
	(-0.04)	(0.21)
3	0.0019	0.0010
	(0.51)	(0.30)
4	-0.0058	-0.0040
	(-1.58)	(-1.12)
5	-0.0068	-0.0046
	(-2.01)	(-1.45)

Table III

Individual stock lock-up expirations and returns during the expanded crash period.

Stocks are divided into three portfolios each day. Stocks with expired lock-ups were those whose lock-ups expired at least 66 trading days before. Stock with lock-ups currently expiring had expiration dates from five trading days in the future to 65 trading days past. Stock with expired lock-ups were those with expirations more than 65 days before. The number of stocks with lock-ups in effect ranged from 130 to 141. The number with lock-ups currently expiring ranged from 77 to 88. The number of stocks with lock-ups that had already expired ranged from 136 to 163.

Panel A. Mean returns for stocks with lock-ups in effect, currently expiring, and already expired.

	Average Returns for Stocks with			T-statistic for difference between	
Date	Lock-ups Expired	Lock-ups Currently Expiring	Lock-ups in Effect	Expired and Expiring Lock-ups	Lock-ups in Effect and Expiring
3/13/2000	-0.0168	-0.0292	-0.0179	1.57	1.44
3/14/2000	-0.0297	-0.0201	-0.0254	-1.12	-0.61
3/15/2000	-0.0458	-0.0462	-0.0394	0.05	0.80
3/16/2000	0.0078	-0.0098	-0.0327	2.45	-3.17
3/17/2000	0.0052	0.0098	0.0064	-0.66	-0.43
3/20/2000	-0.0585	-0.0716	-0.0670	1.66	0.53
3/21/2000	-0.0105	-0.0345	-0.0312	2.96	0.35
3/22/2000	0.0308	0.0328	0.0394	-0.24	0.56
3/23/2000	0.0098	0.0158	0.0164	-0.62	0.06
3/24/2000	0.0109	0.0002	-0.0013	1.25	-0.15
3/27/2000	-0.0017	-0.0173	-0.0019	2.03	1.81
3/28/2000	-0.0258	-0.0252	-0.0325	-0.09	-0.95
3/29/2000	-0.0484	-0.0493	-0.0547	0.12	-0.64
3/30/2000	-0.0570	-0.0695	-0.0720	1.66	-0.30
3/31/2000	0.0094	-0.0031	-0.0019	0.94	0.09
4/3/2000	-0.0974	-0.1179	-0.1079	1.94	0.88
4/4/2000	-0.0592	-0.0785	-0.0722	1.56	0.46
4/5/2000	0.0041	-0.0035	0.0115	0.66	1.10
4/6/2000	0.0442	0.0671	0.0578	-1.63	-0.60
4/7/2000	0.0323	0.0360	0.0526	-0.32	1.29
4/10/2000	-0.0621	-0.0632	-0.0522	0.13	0.98
4/11/2000	-0.0604	-0.0642	-0.0645	0.47	-0.03
4/12/2000	-0.0983	-0.1226	-0.1142	2.65	0.83
4/13/2000	-0.0607	-0.0607	-0.0662	-0.00	-0.43
4/14/2000	-0.1366	-0.1594	-0.1661	1.83	-0.47
4/17/2000	-0.0288	-0.0256	-0.0308	-0.18	-0.24
Average	-0.0286	-0.0350	-0.0334	0.73	0.12
Cumulative	-0.5409	-0.6083	-0.6138	3.28	-0.25

Panel B. Regressions of stock returns on dummies for lock-ups in effect, lock-ups currently expiring, lock-ups already expired, and internet sector.

	Lock-ups Expired		Lock-ups in Effect			
Date	Coefficient	T-statistic	Coefficient	T-statistic	P-value of Sector's Contribution	R^2
3/13/2000	0.0115	1.34	0.0119	1.38	0.0022	0.0905
3/14/2000	-0.0100	1.19	-0.0054	-0.63	0.0005	0.0987
3/15/2000	-0.0022	-0.28	0.0058	0.69	0.1700	0.0502
3/16/2000	0.0144	1.98	-0.0253	-3.34	0.0486	0.1437
3/17/2000	-0.0039	-0.54	-0.0013	-0.16	0.3505	0.0379
3/20/2000	0.0108	1.31	0.0046	0.51	0.0501	0.0626
3/21/2000	0.0264	3.10	0.0044	0.46	0.0179	0.0929
3/22/2000	0.0024	0.27	0.0084	0.65	0.4747	0.0338
3/23/2000	-0.0061	-0.59	0.0032	0.28	0.6269	0.0301
3/24/2000	0.0100	1.08	0.0003	0.03	0.4117	0.0387
3/27/2000	0.0171	2.04	0.0141	1.55	0.8196	0.0323
3/28/2000	0.0004	0.05	-0.0064	-0.83	0.9027	0.0207
3/29/2000	-0.0053	-0.68	-0.0087	-1.05	0.0099	0.0734
3/30/2000	0.0124	1.61	-0.0027	-0.30	0.2299	0.0541
3/31/2000	0.0036	0.27	-0.0046	-0.35	0.0040	0.0789
4/3/2000	0.0186	1.73	0.0069	0.63	0.0002	0.1061
4/4/2000	0.0198	1.55	0.0107	0.76	0.3564	0.0423
4/5/2000	0.0110	0.94	0.0169	1.23	0.0473	0.0617
4/6/2000	-0.0205	-1.45	-0.0094	-0.59	0.3098	0.0444
4/7/2000	-0.0004	-0.03	0.0145	1.11	0.0081	0.0773
4/10/2000	-0.0000	-0.00	0.0138	1.22	0.0003	0.1000
4/11/2000	-0.0001	-0.01	-0.0024	-0.25	0.4661	0.0320
4/12/2000	0.0200	2.19	0.0060	0.60	0.0003	0.1088
4/13/2000	-0.0024	-0.24	-0.0030	-0.22	0.6800	0.0251
4/14/2000	0.0239	1.80	-0.0068	-0.47	0.1927	0.0610
4/17/2000	-0.0016	-0.09	-0.0037	-0.17	0.0192	0.0639
Cumulative	0.0589	3.03	-0.0065	-0.29	0.0011	0.1104

Table IV.
Explaining Daily Returns of Internet Stocks with Lock-Up Expirations.

Panel A. Regressions of daily returns of the equal-weighted portfolio of internet stocks on the CRSP equal-weighted market return, the number of expirations that day, the number from that day through the next five days, the dollar value of shares unlocked that day, and the dollar value of shares unlocked in the next five days.

Intercept	EW Market Return	Number Expirations on Day	Number Expirations Over Six Days	Dollar Value Expirations on Day	Dollar Value Expirations Over Six Days	R^2
			Entire Period			
-0.00021	2.415	0.000266	-0.000393			0.5626
(-0.34)	(36.58)	(0.46)	(-2.20)			
-0.00056	2.415			-8.57×10^{-14}	-1.42×10^{-13}	0.5620
(-1.03)	(36.38)			(-0.42)	(-1.44)	
			July 1, 1998 through December 31, 1999			
0.00319	2.596	0.000835	-0.000451			0.4547
(1.73)	(15.80)	(0.61)	(-0.93)			
0.00296	2.589			2.29×10^{-14}	-1.85×10^{-13}	0.4546
(1.95)	(15.85)			(0.06)	(-0.90)	
			July 1, 1998 through December 31, 2001			
0.00170	2.649	0.000608	-0.000731			0.6318
(1.26)	(30.61)	(0.97)	(-2.97)			
.000315	2.646			-2.18×10^{-16}	-2.21×10^{-13}	0.6292
(0.31)	(30.38)			(-0.00)	(-2.00)	
			January 1, 2000 through December 31, 2000			
-0.00420	2.663	0.000252	-0.000208			0.8885
(-3.46)	(31.63)	(0.44)	(-0.91)			
-0.00484	2.660			-8.16×10^{-16}	-3.34×10^{-13}	0.8882
(-5.81)	(31.61)			(-0.39)	(-0.30)	

Panel B.

Predicted and actual returns for the expanded crash period of March 13,2000 through April 17, 2000. Returns are predicted using coefficients from the regressions in Panel A, returns on the CRSP eqaul-weighted index and number of lock-up expirations and dollar values of lock-up expirations during the crash period.

	Regression Estimated 7/1/1998 - 12/31/2001		Regression Estimated 7/1/1998 - 12/31/1999	
Total Continuously Compounded Return	-58.16%	-58.16%	-58.16%	-58.16%
Return from Market-Wide Decline	-42.27%	-42.27%	-41.53%	-41.53%
Return from Number of Expirations	-13.29%		-6.75%	
Return from Dollar Value of Expirations		-8.23%		0.14%

Table V.

Regressions of daily internet portfolio returns on the contemporaneous number of internet IPOs and SEOS and the amount raised in the offerings.

The internet index is an equal-weighted index of all internet companies that went public between January 1996 and December 2000. The sample is obtained from Jay Ritter's website http://bear.cba.ufl.edu/ritter/. Offers are defined as the number of IPOs and SEOs that took place on a particular day. The dollar values of offers are obtained from SDC.

Period	Intercept	R_t^{EWMkt}	Offers	Value of Offers ($billions)	Log of Offer Values	Adj. R^2
2/9/1996 - 12/31/2000	-0.0007	2.50	-0.0003			0.5181
	(-1.10)	(36.45)	(-0.53)			
2/9/1996 - 12/31/2000	-0.0008	2.50		-0.0015		0.5181
	(-1.26)	(36.45)		(-0.49)		
2/9/1996 - 12/31/2000	-0.0006	2.49			-0.0002	0.5182
	(-0.87)	(36.45)			(-0.79)	
1/1/1999 - 12/31/2000	-0.0019	2.87	-0.0002			0.6727
	(-1.81)	(32.16)	(-0.36)			
1/1/1999 - 12/31/2000	-0.0020	2.86		-0.0010		0.6726
	(-2.14)	(32.18)		(-0.32)		
1/1/1999 - 12/31/2000	-0.0014	2.87			-0.0003	0.6731
	(-1.21)	(32.31)			(-0.92)	

Table VI

Cross-sectional regressions of returns of internet stocks on changes in short interest as a percentage of shares outstanding.

Short interest is obtained for every Nasdaq-listed internet stock as of three business days before the 15th of each month . For each stock each month, short-interest is divided by the number of outstanding shares.

Month Ending	Intercept	Change in Short Interest as a Percentage of Shares Outstanding	Number of Stocks
7/12/1999	0.204 (7.43)	0.482 (0.16)	145
8/10/1999	-0.313 (-25.39)	-0.260 (-0.30)	175
9/12/1999	0.369 (12.52)	-0.037 (-0.02)	211
10/12/1999	0.054 (2.98)	2.804 (1.39)	221
11/10/1999	0.214 (8.53)	3.510 (1.65)	256
12/12/1999	0.295 (11.15)	1.269 (0.56)	278
1/11/2000	0.004 (0.21)	-0.928 (-0.75)	312
2/10/2000	0.142 (7.23)	-0.901 (-0.64)	316
3/12/2000	0.124 (6.13)	-1.123 (-0.69)	335
4/11/2000	-0.401 (-42.54)	-0.366 (-0.58)	356
5/10/2000	-0.271 (-25.21)	-1.026 (-1.09)	376
6/12/2000	0.0925 (6.28)	0.669 (0.44)	375

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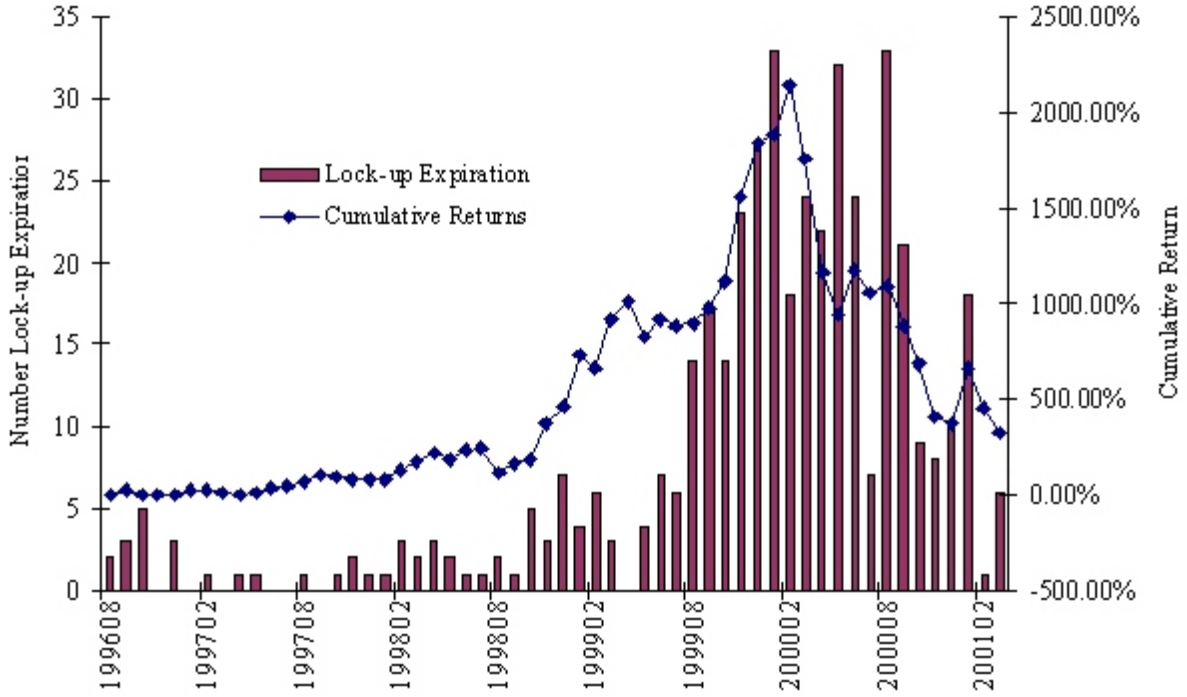

Figure 1a. Cumulative returns of the equal-weighted portfolio of internet stocks and the number of lock-up expirations by month.

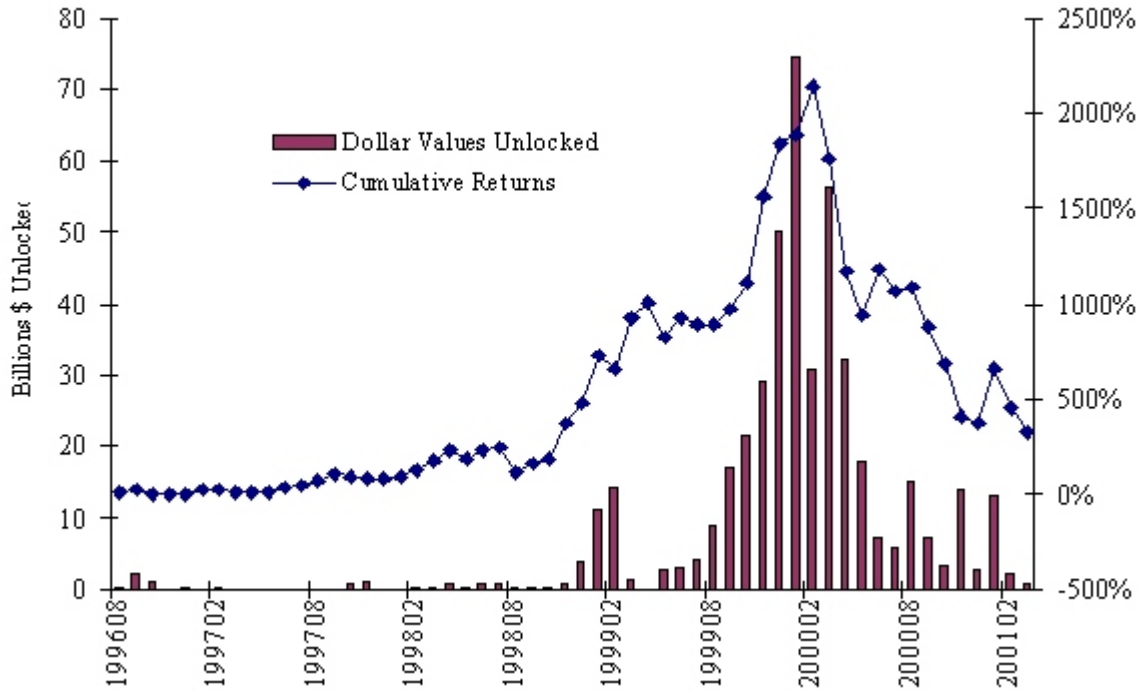

Figure 1b. Cumulative returns of the equal-weighted portfolio of internet stocks and values of unlocked securities in $ billions. Unlocked securities are approximated by multiplying the market capitalization on the expiration date by the percentage of shares not sold in the IPO.

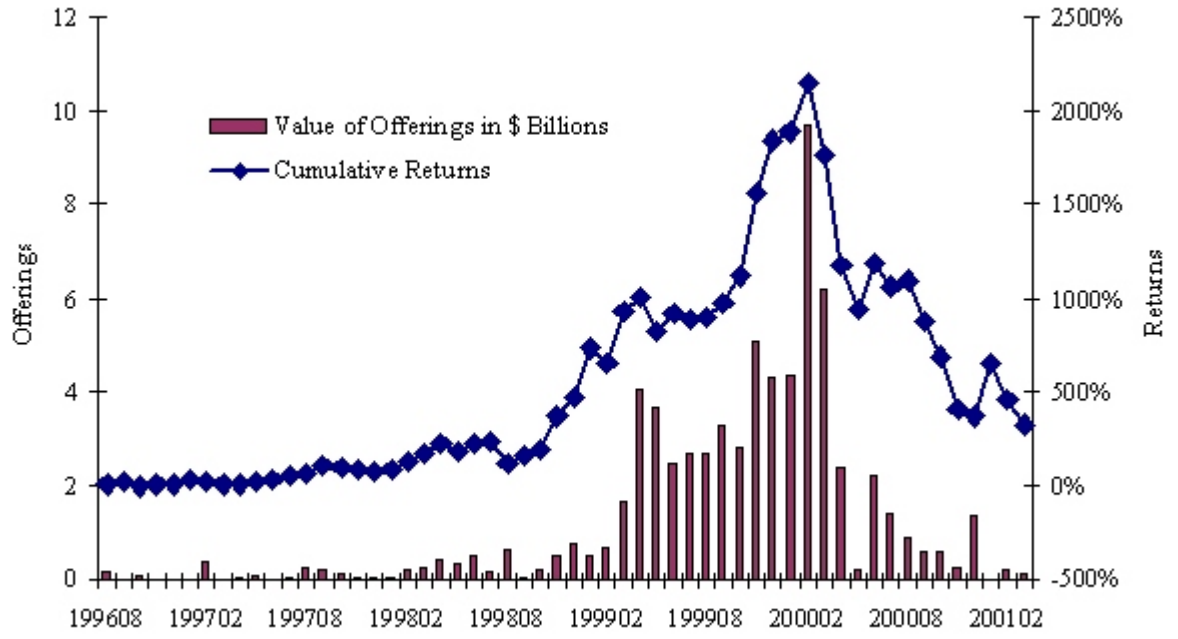

Figure 1c. Cumulative returns of the equal-weighted portfolio of internet stocks and proceeds from Internet Stock IPOs and SEOs in billions of dollars.

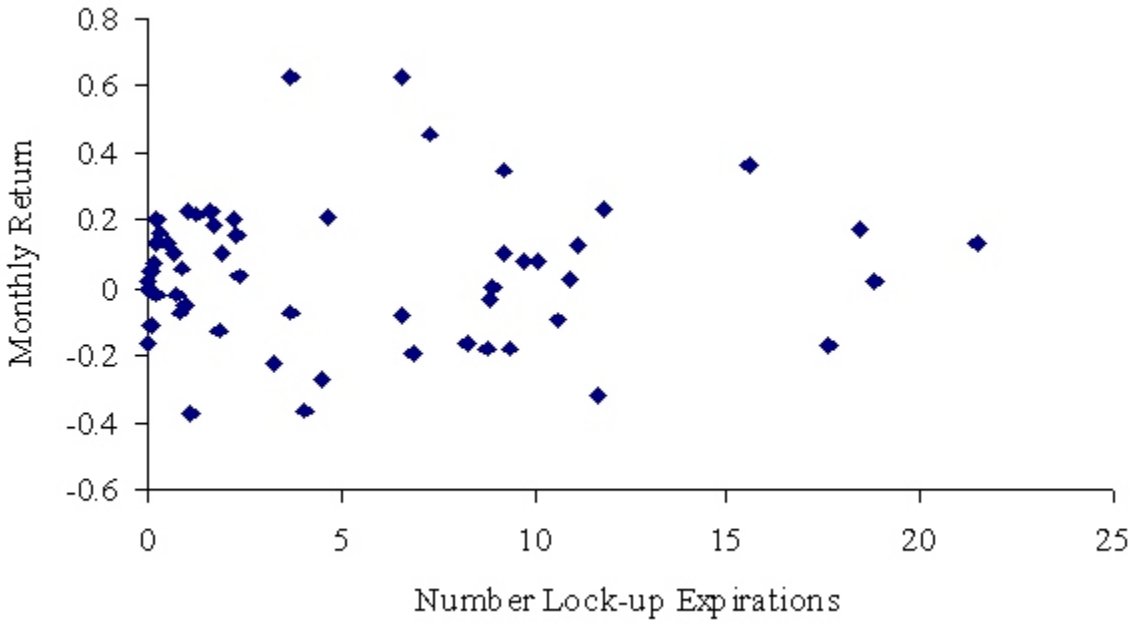

Figure 2a. Monthly returns for the equal-weighted portfolio of all internet stocks and the number of stocks with lock-up expirations for the 56 months from August 1996 through march 2001.

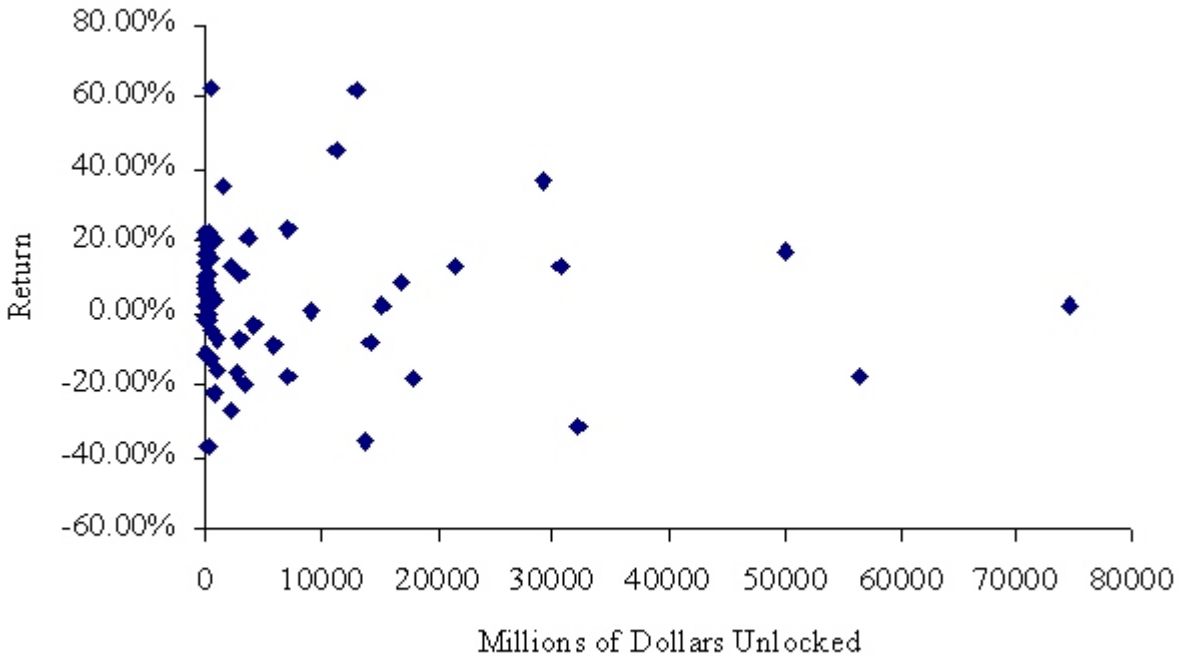

Figure 2b. The monthly returns of the equal-weighted portfolio of all internet stocks plotted against the dollar value of shares unlocked during the month for the 56 months from August 1996 through march 2001.

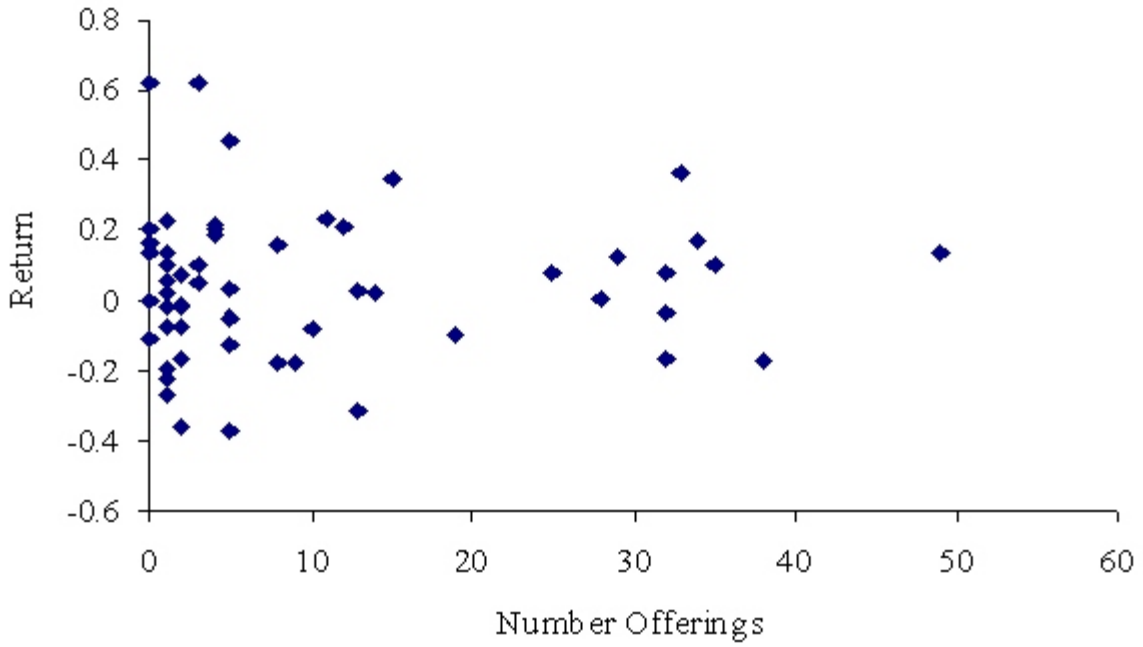

Figure 2c. The monthly returns of the equal-weighted portfolio of all internet stocks plotted against the number of IPOs and SEOS of Internet stocks during the month for the 56 months from August 1996 through march 2001.