THE JOURNAL OF FINANCE • VOL. LXIII, NO. 1 • FEBRUARY 2008

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

PAUL SCHULTZ*

ABSTRACT

Over March and April 2000, Internet stocks lost 56%, or $700 billion. This sudden collapse has been attributed to an increasing supply of shares from lockup expirations and equity offerings. I show that Internet stocks collapsed in this period regardless of whether their lockups expired. Furthermore, daily Internet stock portfolio returns were almost unaffected by the number or dollar amount of lockup expirations that day, or by the amount of stock offered in IPOs or SEOs. Most of the Internet stock decline is explained by poor marketwide returns, particularly for growth stocks.

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 56% between March 10, 2000, and April 17, 2000, with declines of 10.6% on April 3, 10.9% on April 12, and 15.2% on April 14. Over this period, the capitalization of these stocks fell by over $718 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. Lockup expirations and follow-on offerings made billions of dollars worth of shares in Internet stocks available to public investors near their market peak. A number of authors, including Cochrane (2003), Ofek and Richardson (2003), and Hong, Scheinkman, and Xiong (2006), observe that if the demand curves for these stocks were downward sloping, the sharp increase in the supply of shares in early 2000 could explain the collapse of Internet stocks.

There are several reasons why the demand curves for Internet stocks might be downward sloping. First, it is possible that the increase in the number of shares of Internet stocks was so large that it materially tilted the weightings in a typical investor's portfolio toward these risky stocks. This seems unlikely. At their peak, Internet stocks made up 6% 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 share prices and correspondingly higher expected returns would be required to entice investors with less favorable opinions to hold the additional shares. It is certainly true

*Paul Schultz is from the University of Notre Dame. I am grateful for comments by Robert Battalio, Pete Kyle, Tim Loughran, Wei Xiong, and seminar participants at the University of Notre Dame, the 2006 Oxford Finance Symposium, and the 2007 American Finance Association meetings. I remain entirely responsible for blunders, gaffes, etc.

that investors had diverse opinions about Internet stocks. But there is also an implicit assumption here that short sales were constrained. With no short-sale constraints, the views of pessimistic investors would have been incorporated in stock prices even before the supply of shares was increased. Finally, Cochrane (2003) 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 stock prices.

I do find that an increase in the supply of shares affects prices of individual Internet stocks. On average, an Internet stock in my sample earns market-adjusted returns of −6.7% over the 6 days up to and including its lockup 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. Regressions indicate that only a small proportion of monthly or daily returns of Internet indices can be explained by the contemporaneous number of lockup 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 specific Internet stocks during 2000 either. During the meltdown of Internet stocks in March and April 2000, stocks with lockup provisions in effect, and hence a fixed supply of shares, performed worse than stocks with expired lockup provisions and potentially increasing public floats.

Most of the decline in Internet stock prices in March and April 2000 can be explained by their high betas and the poor returns of the equal-weighted market during this time. Other growth and technology stocks also declined precipitously over this period, even if they had nothing to do with the Internet. Examples include companies in the Fama–French "measuring and control equipment" industry, which lost 27% during this period, and pharmaceutical industry stocks, which declined 41% on average. Of course, this does not mean that poor returns on the market "caused" the collapse of Internet stocks. But it does mean that when an increase in the supply of Internet shares is weighed against other explanations for the crash of Internet stocks, their ability to explain the decline of other growth stocks should also be considered.

Determining why Internet stock prices collapsed is interesting in and of itself, but it can also shed light on why these stocks' prices were so high in the first place. If Internet stocks crashed when supply increased, this would suggest that a limited supply of shares was partly responsible for high prices. My findings, which cast doubt on the conjecture that the Internet stock crash was 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 the collapse of Internet 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. Increases in the Supply of Publicly Available Shares and the Collapse of Internet Stocks

When a firm goes public, insiders usually sign an agreement with the underwriters in which they commit to hold, or lock up, their shares for a set period of time. In about 90% of the IPOs in my sample, the lockup period lasts for 180 days or about 6 months from the offering date. As soon as the lockup expires, insiders are free to sell shares subject to SEC and exchange limitations on the amount to be sold at a particular time. Lockup expiration dates are stated in the IPO prospectus, and hence selling at expirations should be anticipated by the market.

The peak of Internet stock valuations coincided with a large number of lockup expirations that significantly increased 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 1 shows cumulative raw returns for this index and the dollar value of shares unlocked 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. 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. Internet stocks returned about 950% between September 1998 and February 2000. But as Figure 1 shows, the value of Internet stocks peaked at the same time that shares with a large dollar value became unlocked. Over 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. Figure 1 also shows that prices of Internet stocks fell abruptly soon after lockup expirations peaked in early 2000, losing most of their value in 3 months.

This graph makes clear why several prominent economists have asserted that, in the presence of downward-sloping demand curves, an increase in the supply of shares was behind the collapse of Internet stock prices.[1] In the view of Ofek and Richardson (2003), the rapid rise in Internet stock prices from mid-1998 through February 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 into 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

[1] See Harris and Gurel (1986), Shleifer (1986), Lynch and Mendenhall (1997), and Wurgler and Zhuravskaya (2002) for evidence of downward-sloping demand curves obtained from additions to stock indices.

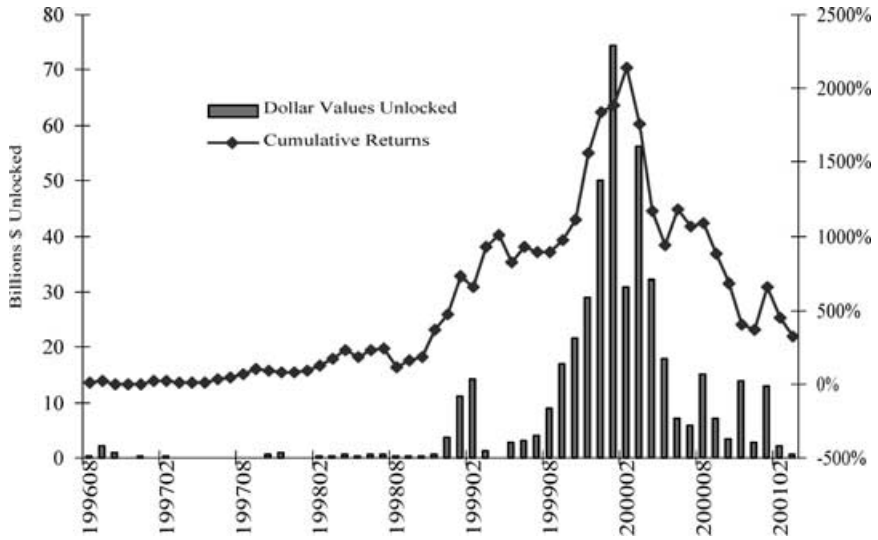

Figure 1. Cumulative returns of the equal-weighted portfolio of Internet stocks and values of unlocked securities in $ billions. Unlocked securities are approximated by multiplying the market capitalization on the expiration date by the percentage of shares not sold in the IPO. The sample includes 452 Internet firms that went public between January 1996 and December 2000.

shares were locked up. Ofek and Richardson argue that the collapse of Internet stock prices occurred as these stocks were released from lockup restrictions, greatly increasing the number of shares available to the public and simultaneously making it easier for short-sellers to borrow shares.[2]

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 5 months from October 1999 though February 2000 than in the 21 months from January 1998 through September 1999. Ofek and Richardson also observe that short interest, as a percentage of outstanding shares, increased significantly for their sample of Internet stocks following lockup expirations. Finally, the number of insider sale transactions in 2000 exceeded the total for 1998 and 1999.

Battalio and Schultz (2006) dispute the claim by Ofek and Richardson (2003) that Internet stocks were difficult to short. They show that options allowed investors to construct synthetic short positions for a sample of actively traded

[2] An alternative explanation is provided in papers by Hao (2005) and Purnanandam, Aggarwal, and Wu (2006). During the late 1990s and early 2000, laddering, the tying of IPO allocations to aftermarket purchases, was a common practice. These researchers show that laddering could lead to high aftermarket prices of IPOs and poor long-run performance.

Internet stocks at a modest cost. Their limited data do not allow them to examine the costs of constructing synthetic short positions for all Internet stocks, but they do demonstrate that portfolios of synthetic shorts formed from their sample closely tracked Internet stock indices in 2000.

Cochrane (2003) also considers the impact of an increasing supply of shares on Internet stocks, but with an ingenious 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 who expected to turn over their positions and reap trading profits in only a few days willingly paid more than the intrinsic value of the stocks. 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 (2006) consider how a small supply of shares and short-sale restrictions can cause stock prices to exceed fundamental values, and how lockup 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 lockup provisions expire and additional shares come on the market, stock prices fall for three reasons. First, investors who are optimistic about the stock and hold shares but are risk-averse will require a higher rate of return to include more shares in their portfolios. If enough shares come on the market, prices must fall sufficiently to induce less optimistic investors to hold the shares. Second, different future private signals of value offer the possibility that the currently optimistic investors will be able to sell out to other investors at a future date who are even more optimistic. Additional shares outstanding decrease 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 firm value that they do. When lockup periods expire, the currently optimistic shareholders expect insiders to hold on to their shares. But the overconfident investors are inevitably disappointed when insiders sell. In this model all of these factors, the 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 lockup expirations.

II. Sample

My sample of Internet stocks is based on the list of Internet stock IPOs maintained by Jay Ritter on his website, http://bear.cba.ufl.edu/ritter/. I augment this sample with a handful of additional companies that went public between January 1996 and December 2000 that are described in their prospectuses as

Table I
Sample Characteristics

The sample of Internet stocks includes Internet stocks listed on Jay Ritter's Web site, http://bear.cba.ufl.edu/ritter/. 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's capitalization on the lockup 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	482
Number of Internet stock IPOs	452
Median percent shares issued in IPO	18.3%
Mean percent shares issued in IPO	21.9%
Median value of shares unlocked	$294 million
Mean value of shares unlocked	$1,060 million
Mean daily return 7/1/1998 until 3/10/2000	0.546%
Mean daily turnover 7/1/1998 until 3/10/2000	2.997%
Mean daily return 3/10/2000 until 12/31/2001	−0.229%
Mean daily turnover 3/10/2000 until 12/31/2001	1.118%
Mean daily return 3/13/2000 to 4/17/2000	−3.162%
Mean daily turnover 3/13/2000 to 4/17/2000	1.793%
Mean daily return 4/10/2000 to 4/14/2000	−8.903%
Mean daily turnover 4/10/2000 to 4/14/2000	1.808%

Internet businesses.[3] The sample also contains a small number of Internet companies that were spun-off from other firms. In total, there are 482 Internet stocks in the sample with CRSP returns during part of the 1996 through 2000 period. For Internet companies that conducted IPOs between January 1996 and December 2000, I obtain lockup expiration dates from Securities Data Corporation (SDC). If missing on SDC, lockup 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 IPOs for 452 of the 482 Internet stocks.

Table I provides sample characteristics. The median percentage of shares issued in the IPO is 18.3%, while the mean proportion is 21.9%. Following Fields and Hanka (2001), I approximate the value of shares unlocked by multiplying the firm capitalization on the lockup expiration date by the proportion of shares not issued in the IPO. The median value of shares unlocked for the sample firms is $294 million, while the mean value is just over $1 billion. Table I provides mean daily returns and turnover for four periods. During the run-up period, from July 1, 1998, through the peak on March 10, 2000, the average daily return of Internet stocks was 0.546% while the mean daily turnover was 2.997%. This turnover figure lends credence to Cochrane's convenience yield theory. Most Nasdaq trading was taking place on Electronic Communication

[3] The companies, their CRSP permanent numbers, and their offer dates are (1) Fine.Com, 85290, 8/11/1997; (2) Perfumania.Com, 87216, 9/29/1999; and (3) Lifeminders.Com, 87396, 11/19/1999.

Networks (ECNs) 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 1 month that constitutes the expanded crash period, Internet stocks had average daily returns of −3.16%. For the 5-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. Lockup Expirations and Stock Returns

Lockup 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 reason for the emphasis on lockup expirations is 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 lockup expirations for my sample of Internet IPOs. I obtain lockup expiration dates from SDC or from offering prospectuses for 451 of the sample stocks. Short trading histories for most of the stocks make it difficult to estimate individual firm betas, so I estimate abnormal returns in two ways that do not require them. First, I calculate market-adjusted abnormal returns around the lockup expiration using CRSP equal-weighted and value-weighted portfolios. I also estimate market model excess returns using beta coefficients estimated by regressions of the equal-weighted portfolio of Internet stocks on the CRSP equal-weighted and value-weighted portfolio over the entire sample period. The estimated beta with respect to the equal-weighted portfolio is 2.42 while the estimated beta with respect to the value-weighted portfolio is 1.58. Results are shown in Table II.

Like other studies, I find negative excess returns around lockup expirations. In the case of Internet stocks though, performance around lockup expirations is particularly bad. When the CRSP equal-weighted index is used as a benchmark, the market-adjusted lockup expiration date return is −1.80%, with a *t*-statistic of −4.09. The sum of the excess returns over the 6 days ending on the expiration date is −6.71%.[4] When the CRSP value-weighted index is used, the mean excess

[4] Market-adjusted returns are not significantly different from zero for days −9 through −6.

Table II
Excess Returns Around Lockup Expirations

Market-adjusted returns are calculated as the difference between the stock's return and either the CRSP equal-weighted or value-weighted return that day. Robust *t*-statistics are given in parentheses under the mean excess returns and are based on the cross-sectional standard deviation of excess returns for that event date. Market model excess returns are calculated using a beta of 2.42 for the equal-weighted index and 1.58 for the value-weighted index. These values are obtained by regressing the portfolio of Internet stocks on the market over the entire sample period. The number of observations across the 11-day event window ranges from 450 to 452.

Event Date	Market-Adjusted Return Using the CRSP Equal-Weighted Index	Market Model Excess Returns Calculated with the CRSP Equal Weighted Index	Market-Adjusted Return Using the CRSP Value-Weighted Index	Market Model Excess Returns Calculated with the CRSP Value Weighted Index
−5	−0.0113	−0.0110	−0.0098	−0.0088
	(−2.83)	(−2.89)	(−2.44)	(−2.22)
−4	−0.0114	−0.0129	−0.0108	−0.0111
	(−2.83)	(−3.22)	(−2.67)	(−2.73)
−3	−0.0065	−0.0085	−0.0057	−0.0061
	(−1.77)	(−2.38)	(−1.55)	(−1.66)
−2	−0.0074	−0.0100	−0.0074	−0.0084
	(−2.07)	(−2.84)	(−2.05)	(−2.34)
−1	−0.0125	−0.0143	−0.0119	−0.0123
	(−3.14)	(−3.69)	(−2.97)	(−3.09)
0	−0.0180	−0.0178	−0.0178	−0.0176
	(−4.09)	(−4.10)	(−3.99)	(−3.94)
1	−0.0024	−0.0029	−0.0020	−0.0018
	(−0.53)	(−0.68)	(−0.42)	(−0.41)
2	−0.0001	−0.0020	0.0013	0.0013
	(−0.02)	(−0.53)	(0.34)	(0.34)
3	0.0019	−0.0006	0.0010	0.0021
	(0.52)	(−0.16)	(0.30)	(0.56)
4	−0.0054	−0.0068	−0.0040	−0.0036
	(−1.51)	(−1.90)	(−1.08)	(−0.99)
5	−0.0068	−0.0077	−0.0074	−0.0081
	(−2.02)	(−2.35)	(−2.17)	(−2.39)

return is −1.78% on the expiration date and the sum of the excess returns for the six days ending on the expiration day is −6.34%. Market model results are similar despite the high betas of Internet stocks. As a whole, the event study 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 5 days up to and including the lockup expirations is −4.11%.[5]

There are two reasons why performance may be poor in the days leading up to the lockup expiration as well as on the expiration date itself. First, the lockups are agreements between the shareholders of the company that is going public

[5] Very similar results obtain when abnormal returns are calculated as the difference between the returns on the stocks with lock-up expirations and an equal-weighted index of Internet stocks.

and the underwriters, and underwriters may release shareholders from their lockup restrictions early. Second, in some cases there is ambiguity about the actual expiration date. As an example, for one of the IPOs a lockup was said to be in effect for 180 days in one place in the prospectus, and for 6 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 Lockup Expirations Explain the Crash of Internet Stocks?

If lockups expired for a large number of Internet stocks around the same time, it is possible that the performance of these stocks could depress the average performance of the entire Internet sector. To test this, I examine the expanded 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 lockup periods, stocks with currently expiring lockup periods, and stocks for which the lockup period was still in effect. A stock has a currently expiring lockup if the lockup expiration is no more than 5 trading days in the future and no more than 65 trading days past. This allows me to include the entire period of negative excess returns before the official expiration date and up to (roughly) 3 months after. The lockup period is expired if it is at least 66 trading days after the expiration date. Stocks have their lockup in effect if there is at least 6 days until the expiration date. Mean returns are calculated for each of the three portfolios for each day during the expanded crash period. The cross-sectional standard deviations of returns within the portfolios are used to perform t-tests for differences in means across the portfolios.

The results are shown in Table III. Differences in returns across the three categories of stocks are minimal. If lockup expirations were behind the crash in Internet stock prices, we would expect stocks with lockups still in effect to perform best. Over the entire expanded crash period, however, the cumulative return on stocks with lockups in effect is −60.01%, similar to the cumulative return of −61.75% for stocks with currently expiring lockups and lower than the −53.83% for stocks with expired lockups. There is no single day over the period on which stocks with lockups in effect outperform stocks with expiring lockups by a statistically significant amount. Thus, the performance of stocks with a fixed supply of shares was similar to or worse than the performance of 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 was responsible for the collapse of Internet stock prices.

Stocks with currently expiring lockups underperform stocks with expired lockups by a statistically significant amount on a few individual days and over the entire period. But the stocks with expired lockups lose 53.83% over the period, again making it difficult to argue that the collapse of Internet stock prices was due to lockup expirations.

Table III
Individual Stock Lockup Expirations and Returns during the Expanded Crash Period

Stocks are divided into three portfolios each day. Stocks with expired lockups are those whose lockups expired at least 66 trading days before. Stocks with lockups currently expiring have expiration dates from 5 trading days in the future to 65 trading days past. Stocks with lockups in effect are those with lockup expirations more than 5 days in the future. The number of stocks with lockups in effect ranges from 132 to 143. The number with lockups currently expiring ranges from 80 to 91. The number of stocks with lockups that have already expired ranged from 151 to 180.

	Average Returns for Stocks with			*t*-Statistic for Difference between	
Date	Lockups Expired	Lockups Currently Expiring	Lockups in Effect	Expired and Expiring Lockups	Lockups in Effect and Expiring
3/13/2000	−0.0162	−0.0290	−0.0177	1.49	1.30
3/14/2000	−0.0290	−0.0192	−0.0253	−1.14	−0.70
3/15/2000	−0.0465	−0.0461	−0.0394	−0.06	0.87
3/16/2000	0.0086	−0.0109	−0.0331	2.54	−2.87
3/17/2000	0.0049	0.0108	0.0066	−0.78	−0.55
3/20/2000	−0.0583	−0.0712	−0.0670	1.61	0.51
3/21/2000	−0.0125	−0.0343	−0.0314	2.35	0.30
3/22/2000	0.0333	0.0322	0.0387	0.10	0.57
3/23/2000	0.0110	0.0156	0.0165	−0.46	0.09
3/24/2000	0.0093	0.0002	−0.0011	1.00	−0.14
3/27/2000	0.0016	−0.0173	−0.0018	2.28	1.81
3/28/2000	−0.0248	−0.0252	−0.0323	0.05	−0.97
3/29/2000	−0.0467	−0.0493	−0.0547	0.33	−0.66
3/30/2000	−0.0548	−0.0695	−0.0715	1.84	−0.24
3/31/2000	0.0061	−0.0031	−0.0020	0.74	0.09
4/3/2000	−0.0977	−0.1179	−0.1071	1.85	0.94
4/4/2000	−0.0578	−0.0785	−0.0712	1.70	0.57
4/5/2000	0.0016	−0.0035	0.0107	0.43	1.14
4/6/2000	0.0426	0.0671	0.0571	−1.95	−0.76
4/7/2000	0.0353	0.0360	0.0523	−0.06	1.27
4/10/2000	−0.0609	−0.0632	−0.0517	0.22	1.05
4/11/2000	−0.0609	−0.0642	−0.0639	0.41	0.04
4/12/2000	−0.0978	−0.1226	−0.1135	2.70	0.95
4/13/2000	−0.0600	−0.0607	−0.0657	0.06	−0.38
4/14/2000	−0.1343	−0.1594	−0.1654	1.92	−0.43
4/17/2000	−0.0320	−0.0256	−0.0319	−0.32	−0.30
Average	−0.0293	−0.0349	−0.0330	0.73	0.13
Cumulative	−0.5383	−0.6175	−0.6001		

These results seem insensitive to the definition of expiring versus expired lockups. When "currently expiring" is defined as an expiration date no more than 5 trading days in the future and no more than 180 trading days past, cumulative returns are −57.62% for stocks with currently expiring lockups and −54.40% for stocks with expired lockups.

It is possible that an Internet stock's lockup 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 lockups and lockups 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 Internet stocks 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 on dummy variables for whether lockup provisions were expired or still in effect. Results (not shown to save space) again indicate that there is little difference in either the daily or cumulative returns for stocks with lockups in effect, expiring, or expired.

As a whole, Table III shows that all Internet stocks crashed in March and April 2000 regardless of whether their lockup provisions were expiring, had already expired, or had yet to expire. Given these results it is difficult to argue that individual stocks crashed as their lockups expired and that large numbers of individual stocks with expiring lockups made the entire industry crash.

C. Lockup 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 lockup expiration in some stocks led to price declines in Internet stocks generally. Greenwood (2005) 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. As a result, 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 (2005) tests his model using a unique event. In April 2004, the Nikkei 225 index was reweighted. 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 1 week between the announcement of the reweighting 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 10 weeks. Of more interest though is the return 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 reweighted. 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 reweighted.

Greenwood's model and empirical findings have clear implications for the meltdown of Internet stocks. If arbitraguers bought large positions in stocks with expiring lockups, 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 lockup expirations. To test this possibility, I first examine whether returns for the entire sample of Internet stocks during a month are related to the number of stocks with lockup expirations during that month. When I regress the monthly return on the number of lockup expirations during the 56 months from August 1996 through March 2001, the coefficient is −0.0010 with a robust t-statistic of −0.38. 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, using monthly data, there is no evidence that returns for Internet stocks were lower during months when there were large numbers of Internet stocks with lockup expirations, or when large dollar values of shares became unlocked.

As an alternative, I use daily returns of various indices that I construct from non-Internet stocks along with the number of lockup expirations and the dollar value of unlocked shares to explain the daily returns of the equal-weighted portfolio of Internet stocks. Regressions are estimated for four different periods. The first is the entire sample period from January 1996 through December 2001. The second, from July 1, 1998, through December 31, 1999, provides estimates of the impact of lockup expirations on Internet stock returns before the bubble burst. The third period extends from July 1, 1998, through December 31, 2000. Regression estimates from this period include much of the run-up 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 run-up in prices. Table II shows that individual stock returns are negative not only on the lockup expiration date but on the 5 days leading up to it as well. Hence I include as explanatory variables the number of lockup expirations and the dollar value of shares unlocked on the 6 days ending on the expiration date.

The results are reported in Table IV. Panel A reports the regression coefficients with robust t-statistics underneath in parentheses. In each of the first

Table IV

Explaining Daily Returns of Internet Stocks with Lockup Expirations

The returns of an equal-weighted portfolio of all Internet stocks are regressed on the returns of market portfolios that do not include the Internet stocks, the number of lockup expirations that day, and the number of lockup expirations over the 6-day period ending that day. Robust t-statistics are reported in parentheses under regression coefficients. For the crash period of 4/10/2000 through 4/14/2000 and the expanded crash period of 3/13/2000 through 4/17/2000 returns attributable to the market are obtained by multiplying the time-series regression coefficient by the return of the market index to get the return attributed to the market each day. To get the returns attributable to lockup expirations each day, the number of expirations that day and over the previous 5 days are multiplied by their respective regression coefficients. To get the total return from each source for the entire period, the return each day is multiplied by the cumulative return of Internet stocks up to that day and then summed. Other return is the return that cannot be attributed to either the market or lockup expirations.

Panel A: Time-Series Regressions of Internet Stock Returns on Market Returns and Lockup Expirations

	Estimation Period									
	Entire Period	7/1998–12/1999	7/1998–12/2000	1/2000–12/2000	7/1998–12/2000	1/2000–12/2000	7/1998–12/2000	1/2000–12/2000	7/1998–12/2000	1/2000–12/2000
Intercept	−0.0002	0.0036	0.0018	−0.0050	0.0010	−0.0052	0.0006	−0.0056	0.0015	−0.0062
	(−0.47)	(1.99)	(1.35)	(−3.59)	(0.79)	(−4.22)	(0.48)	(−4.10)	(1.07)	(−2.84)
Equal-weight all stocks except Internet Ret_t	2.305	2.356	2.515	2.627						
	(38.62)	(15.25)	(27.85)	(27.37)						
Equal-weight no Internet Nasdaq only Ret_t					2.256	2.204				
					(31.94)	(35.59)				
Equal-weight no Internet Nasdaq only, no dividend, traded before 1996 Ret_t							1.993	1.934		
							(32.39)	(33.42)		
Value-weight no Internet Ret_{t-1}									0.576	0.600
									(7.77)	(5.15)
Value-weight no Internet Ret_t									1.659	1.604
									(19.92)	(12.26)
Value-weight no Internet Ret_{t+1}									−0.192	−0.184
									(−2.43)	(−1.60)
Number expirations that day	0.00024	0.00062	0.00047	0.00015	0.00048	0.00013	0.00035	−0.00007	−0.00061	−0.00119
	(0.39)	(0.44)	(0.69)	(0.23)	(0.80)	(0.23)	(0.54)	(−0.11)	(−0.61)	(−0.96)
Number expirations last six days	−0.00041	−0.00037	−0.00076	−0.00018	−0.00067	−0.00009	−0.00068	−0.00006	−0.00070	−0.00002
	(−2.24)	(−0.76)	(−2.90)	(−0.70)	(−2.93)	(−0.45)	(−2.87)	(−0.28)	(−2.11)	(−0.05)
R^2	0.5971	0.4291	0.6048	0.8515	0.6469	0.8989	0.6226	0.8782	0.5014	0.5572

(*continued*)

Table IV—*Continued*

Panel B: Time-Series Regressions of Internet Stock Returns on Market Returns and Lockup Expirations: Robustness Checks

	Estimation Period									
	Entire Period	7/1998–12/1999	7/1998–12/2000	1/2000–12/2000	7/1998–12/2000	1/2000–12/2000	7/1998–12/2000	1/2000–12/2000	7/1998–12/2000	1/2000–12/2000
Intercept	0.00231	0.00570	0.00377	−0.00474	0.00355	0.00666	−0.01740	0.00440	0.00452	−0.01462
	(3.03)	(2.40)	(1.96)	(−1.39)	(1.21)	(2.90)	(−1.05)	(2.05)	(2.73)	(2.42)
Equal-weight all stocks except Internet Ret_t								2.364	2.511	2.623
								(15.11)	(27.76)	(27.68)
Equal-weight no Internet Nasdaq only, no dividend, traded before 1996 Ret_t										
Number expirations that day	−0.00140	−0.00147	−0.00174	−0.00220						
	(−1.27)	(−0.83)	(−1.42)	(−1.39)						
Number expirations last 6 days	−0.00015	0.00014	−0.00037	0.00033						
	(−0.43)	(0.23)	(−0.83)	(0.55)						
Number expirations last 6 months ($\times 10^4$)					0.00006	−0.00008	0.00009	−0.00005	−0.00007	0.00007
					(1.11)	(−2.93)	(0.76)	(−1.07)	(−4.98)	(1.48)
R^2	0.0033	0.0012	0.0085	0.0063	0.0017	0.0146	0.0031	0.4295	0.6131	0.8527

Panel C: Internet Stock Returns during the Expanded Crash Period (3/13/2000–4/17/2000) Attributable to Market Returns and Lockup Expirations

Market Index	Coefficients Estimated	Return Due to Market	Return Due Expirations	Other Return
Equal-weighted index non-Internet stocks	Entire Period	−26.11%	−6.70%	−25.15%
Equal-weighted index non-Internet stocks	7/1998–12/1999	−26.68%	−4.81%	−26.47%
Equal-weighted index non-Internet stocks	7/1998–12/2000	−28.48%	−12.34%	−17.14%
Equal-weighted index non-Internet stocks	1/2000–12/2000	−29.75%	−2.80%	−25.41%
Equal-weighted index Nasdaq non-Internet stocks	7/1998–12/2000	−40.94%	−10.68%	−6.34%
Equal-weighted index Nasdaq non-Internet stocks	1/2000–12/2000	−40.00%	−1.23%	−16.73%
Equal-weighted index Nasdaq non-Internet, no dividend traded before 1996	7/1998–12/2000	−42.06%	−11.25%	−4.65%
Equal-weighted index Nasdaq non-Internet, no dividend traded before 1996	1/2000–12/2000	−40.82%	−1.30%	−15.84%
Value-weighted index non-Internet stocks with leading and lagging days	7/1998–12/2000	−2.08%	−14.54%	−41.34%
Value-weighted index non-Internet stocks with leading and lagging days	1/2000–12/2000	2.05%	−3.99%	−56.02%
When expirations over the last 6 months are used				
Equal-weighted index non-Internet stocks	7/1998–12/2000	−25.65%	−17.50%	−14.81%
Equal-weighted index non-Internet stocks	1/2000–12/2000	−26.67%	21.03%	−52.32%

(*continued*)

Table IV—*Continued*

Panel D: Internet Stock Returns during the Crash Period (4/10/2000–4/14/2000) Attributable to Market Returns and Lockup Expirations

Market Index	Coefficients Estimated	Return Due to Market	Return Due Expirations	Other Return
Equal-weighted index non-Internet stocks	Entire Period	−25.61%	−1.80%	−9.90%
Equal-weighted index non-Internet stocks	7/1998–12/1999	−26.18%	−0.79%	−10.34%
Equal-weighted index non-Internet stocks	7/1998–12/2000	−27.94%	−2.00%	−7.37%
Equal-weighted index non-Internet stocks	1/2000–12/2000	−29.19%	−0.46%	−7.66%
Equal-weighted index Nasdaq non-Internet stocks	7/1998–12/2000	−32.70%	−1.73%	−2.88%
Equal-weighted index Nasdaq non-Internet stocks	1/2000–12/2000	−31.95%	−0.20%	−5.16%
Equal-weighted index Nasdaq non-Internet, no dividend traded before 1996	7/1998–12/2000	−32.38%	−1.82%	−3.11%
Equal-weighted index Nasdaq non-Internet, no dividend traded before 1996	1/2000–12/2000	−31.42%	−0.21%	−5.68%
Value-weighted index non-Internet stocks with leading and lagging days	7/1998–12/2000	−16.28%	−2.32%	−18.71%
Value-weighted index non-Internet stocks with leading and lagging days	1/2000–12/2000	−15.85%	−0.61%	−20.85%
When Expirations over the Last 6 Months Are Used				
Equal-weighted index non-Internet stocks	7/1998–12/2000	−26.24%	−4.99%	−6.08%
Equal-weighted index non-Internet stocks	1/2000–12/2000	−27.27%	5.21%	−15.25%

four regressions, the equal-weighted portfolio of all CRSP non-Internet common stocks is used as a market index. The coefficient (or beta) of the Internet stock portfolio is very high, ranging from 2.31 for the entire period to 2.63 for the year 2000. The t-statistics for the coefficients are also very high, ranging from 15.25 to 38.62. The coefficient on the number of lockup 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.[6] It is significant at the 5% level when estimated for the entire period and the period from July 1, 1998, through December 31, 2000. The largest coefficient in absolute value is −0.00076. This indicates that 10 lockup expirations in the past 6 days reduces returns by 76 basis points.

It is interesting that R^2's are so high, ranging from 0.4291 for the entire sample period to 0.8515 for the year 2000. Most of the variation in Internet stock prices can be explained by market returns. Little of the variation is idiosyncratic. Coefficients on the number of lockup expiration variables are both insignificant for 2000, and thus over 85% of the variation in Internet stock returns in 2000, a period that included both the dramatic run-up in prices and the Internet crash, can be explained by the returns of non-Internet stocks.

The remaining six regressions in Panel A use three different indices. The first is an equal-weighted index of all non-Internet common stocks that traded on Nasdaq only. It seems likely that this portfolio will have even more explanatory power for Internet stock returns. The second index is an equal-weighted portfolio of all non-Internet stocks that traded on Nasdaq, were listed before 1996, and had not paid a dividend in the prior year. Using firms that were listed before 1996 minimizes the impact of any lockup expirations on the firms' returns. It also reduces the number of firms in the index that are in businesses that are closely related to the Internet. The restriction on dividend payments is intended to create an index of growth firms that are sensitive to the same economic factors as the Internet firms. The third index is a value-weighted portfolio of all non-Internet NYSE/Amex and Nasdaq stocks. In these regressions I include leading and lagging daily returns as the value-weighted index leads the portfolio of Internet stocks. I use only contemporaneous returns for the equal-weighted portfolios because neither leading nor lagging returns were significant in regressions. I report regressions for each of these three indices for two periods: July 1998 through December 2000, and January 2000 through December 2000.

In every regression, coefficients on index returns are quite high. Even when the index is composed entirely of Nasdaq stocks that do not pay dividends, the coefficient on the index return is 1.993 for the 1998 through 2000 period, and 1.934 for the year 2000. The sum of the three coefficients on the value-weighted index exceeds two for each regression. The Internet stocks are highly sensitive to factors that drive returns for the remainder of the market. Coefficients on the number of expirations that day and over the previous 6 days are little affected

[6] The number of expirations on a given day varies from zero to eight. The number over the prior 6 days varies from 0 to 17. The number over the prior 6 months varies from 0 to 168.

by the choice of a market index. The coefficient on the number of expirations in the prior six days ranges from −0.00070 to −0.00067 when the estimation period is over July 1998 through 2000. The number of same-day expirations is always insignificant.

Some robustness checks are reported in Panel B. The first four columns report regressions of Internet stock returns on the number of expirations variables without including market returns. This is a check on the impact of any multicollinearity in the previous regressions. If market returns and the number of Internet stock expirations are highly correlated, the inclusion of both in a regression could obscure the relation between Internet stock returns and lockup expirations. The regressions reveal though, that for the entire period and for each of the subperiods, the number of expirations that day and over the six-day period are insignificant. The R^2's, which had ranged from 0.42 to 0.85 in the regressions with market returns, are all less than 0.01 when the regressions include only the number of expirations.

The remainder of the regressions in Panel B use the number of expirations in the previous 125 trading days (or 6 months) rather than the number that day or the previous few days as an explanatory variable. In practice, this is a variable that is relatively large throughout 2000, and smaller during the rest of the sample period. This variable approximates the total amount of unlocked stock that is available for sale, but is highly autocorrelated and is unlikely to capture sudden shifts in sales of unlocked stock that could bring about sudden stock price moves. The number of expirations in the previous 6 months is negative and significant for regressions estimated over July 1998 through December 2000, but is positive when estimated over 2000 only. The maximum R^2 for these regressions is only 0.0146.

Several other variations on these regressions were tried but are not reported because the lockup expiration variables were less significant. Results are weaker when the dollar value or 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 lockup expirations.

In Panel C of Table IV, I use the regression results from Panel A to estimate the expanded crash period returns due to marketwide stock returns, lockup expirations, and other factors. For each day from March 13, 2000, through April 17, 2000, I estimate the return of the portfolio of Internet stocks that is attributable to the market by multiplying the index return that day by the regression coefficient for the index return. I cumulate the return to Internet stocks from the market by multiplying each day's return attributable to the market by the cumulative return for Internet stocks since the beginning of the crash period and then summing. Bear in mind that these "market" returns do not include Internet stocks. Likewise, for each day I estimate the return attributable to lockup expirations by multiplying the number of expirations that day and the number of expirations over the prior 6 days by the regression coefficients from Panel A. I cumulate the return from lockup expirations by multiplying each day's return

attributable to lockup expirations by the cumulative returns to the Internet index since the start of the crash period and summing. The cumulative return due to other factors is obtained by subtracting the cumulative returns from the market and the cumulative returns from lockup expirations from the total cumulative returns for Internet stocks over the entire crash period.

The first four rows show results when the index used for the market is the equal-weighted index of all non-Internet stocks and coefficients are estimated over various periods. Cumulative returns attributable to the market range from −26.11% to −29.75%. Returns from lockup expirations are much smaller, ranging from −2.80% when coefficients are estimated over 2000 to −12.34% when coefficients are estimated over July 1998 through 2000. A large proportion of the cumulative returns of Internet stocks remains unexplained by either market returns or lockup expirations when I use the equal-weighted portfolio of all stocks.

The next four rows provide crash returns attributable to the market and to lockup expirations when the proxies for the market are the portfolio of all Nasdaq stocks, and the portfolio of all Nasdaq stocks that did not pay dividends and traded on Nasdaq before 1996. Here, a much larger proportion of the crash can be attributed to market returns. In each case, Internet price declines of more than 40% are predicted by the market returns. Returns of −10.68% to −11.25% can be attributed to lockup expirations if I use the coefficients estimated over 1998 to 2000. If I use the coefficients from 2000, returns of only −1.23% to −1.30% can be attributed to lockup expirations.

The next two rows of the table provide crash returns attributable to the market and lockup expirations when the value-weighted index of all non-Internet stocks is used as a proxy for the market. In this case, very little of the Internet stock returns can be attributed to market returns. The coefficients on the market returns are high, but value-weighted indices, unlike equal-weighed indices, declined very little over the expanded crash period.[7] If the coefficients estimated from July 1998 to 2000 are used, a price decline of 2.08% can be attributed to the market while 14.54% can be attributed to lockup expirations. An Internet stock price decline of −41.34% cannot be explained.

In the last two rows of the table, I report crash returns attributable to non-Internet stock returns and the number of lockup expirations over the past 6 months. When July 1998 through 2000 is used for the coefficient estimation, an Internet stock decline of 17.5% can be attributed to lockup expirations over the previous 6 months while a loss of 25.65% can be attributed to declines in non-Internet stocks. When the coefficients are instead estimated over 2000, returns of non-Internet stocks predict a decline of 26.67% for Internet stocks while lockup expirations predict an *increase* of 21% in Internet stock prices.

Panel D replicates Panel C but reports returns over the 1-week crash period of April 10, 2000, through April 14, 2000. Over this period, results are stronger.

[7] I show later that the impact of firm size on crash period returns is small when correlated variables such as profitability, dividend payments, and growth firm dummies are included in cross-sectional regressions.

The cumulative return for the portfolio of Internet stocks is −37.31%. When an equal-weighted index is used, the returns attributable to the market range from −25.61% to −32.70%, while the estimated returns from lockup expirations range from −0.20% to only −2.00%. Even when value-weighted indices are used, returns of −15.85% to −16.28% can be attributed to the market but only 2.32%, at most, to lockup expirations. The last two rows of Panel D show results when lockup expirations over the past 6 months are used to explain the Internet stock crash. At most, lockup expirations explain a decline in prices of −4.99%. If coefficients are estimated over 2000, lockup expirations are actually associated with positive returns for Internet stocks over the crash period.

As a whole, the results in Table IV suggest that the crash of Internet stocks in March and April 2000 was not a result of lockup expirations and was not due to idiosyncratic Internet sector returns. Most of the Internet stock returns during the crash can be attributed to a broader marketwide decline in stock prices.

D. The Marketwide Crash

Although value-weighted indices did not decline much in March and April 2000, broad-based equal-weighted indices fell sharply. To examine more closely which stocks collapsed in the Spring of 2000, I estimate returns for all Nasdaq and NYSE/Amex stocks listed on CRSP for the period of March 13, 2000, through April 17, 2000. Each firm is classified into one of Fama and French's 48 industries based on the CRSP SIC code in effect on March 13, 2000. Internet stocks form a 49th industry and are not included in other industries indicated by their SIC codes.

Table V reports cumulative returns for equal-weighted portfolios of stocks in specific Fama–French industries for the expanded crash period and the crash period. The top row of the table reports cumulative returns of Internet stocks during the expanded crash period and the crash period as well as the percentage of them that had been listed on CRSP less than 1 year or less than 2 years. As we have seen, Internet stocks lost more than half their value over the expanded crash period. More than 75% of the Internet stocks trading on March 13, 2000, had been on CRSP for less than 1 year, and more than 86% had been on CRSP less than 2 years.

In the next five rows, I report crash period returns for five computer-related industries: business services, computers, electronic equipment, measuring and control, and electrical equipment. These stocks also crashed. Returns for these industries ranged from −26.98% to −35.59% for the expanded crash period, and from −19.04% to −24.52% over the 1-week crash period. But, unlike Internet stocks, few of them were recent IPOs. At least 90% of the stocks in each industry had been listed on CRSP for more than 1 year. Hence, there were few lockup expirations for these stocks. Telecommunications stocks are listed next. They lost over 30% of their value during the expanded crash period and 21.29% during the week of April 10, 2000, through April 14, 2000.

Table V
Returns of Stocks in Other Industries during the Internet Crash Period

All CRSP stocks that are not included in the sample of Internet stocks are sorted into 48 Fama–French (1997) industry portfolios based on their CRSP SIC code for March 13, 2000. Equal-weighted industry portfolios are formed, and returns for each portfolio are cumulated over the expanded crash and crash periods.

Industry	Returns: 3/13 –4/17	Returns: 4/10 –4/14	On CRSP < 1 Year	On CRSP < 2 Years	Number of Stocks
Internet	−56.74%	−37.31%	75.1%	86.6%	381
Computer-related Industries					
Business services	−34.30%	−22.51%	9.8%	19.5%	785
Computers	−34.91%	−24.52%	8.6%	10.7%	187
Electronic equipment	−29.61%	−23.62%	5.6%	10.4%	268
Measuring and control	−26.98%	−19.04%	6.7%	9.2%	120
Electrical equipment	−35.59%	−23.22%	7.4%	9.3%	204
Telecommunications					
Telecommunications	−30.77%	−21.19%	24.9%	35.1%	185
Medical Industries					
Health care	−20.13%	−11.98%	4.6%	9.2%	130
Medical equipment	−25.63%	−15.45%	2.2%	4.5%	178
Pharmaceuticals	−41.33%	−23.60%	4.3%	8.7%	277
Other Industries					
Banking	0.68%	−2.97%	5.0%	17.7%	821
Oil and natural gas	−3.82%	−5.45%	6.0%	9.3%	182
Construction materials	−0.62%	−4.57%	3.1%	3.1%	98
All others	−5.35%	−7.52%	3.8%	8.4%	2,777

It is possible that many of these companies' fortunes were tied to the Internet. For some of the computer firms, growth of the Internet could be expected to expand the market for their products. Some of the telecommunications companies expected to provide broadband or cable services to Internet users. It is also possible that investors perceived these stocks to be substitutes for Internet stocks and attempted to decrease their holdings of these stocks when new shares of Internet companies were released to the public.

These arguments are implausible though when we consider the returns of medical stocks that are reported in the next three rows. Healthcare stocks dropped 20.13%, medical equipment shares declined 25.63%, and pharmaceutical companies fell 41.33% over the expanded crash period. At least 95% of the stocks in each of these industries had traded on CRSP for more than 1 year,

hence very few would have experienced lockup expirations during the crash period. It also seems highly unlikely that investors would have considered them to be good substitutes for Internet stocks.

The collapse of Internet stock prices seems to be part of a broader crash of technology and growth stocks in March and April 2000. Sirius Satellite Radio stock fell 47.5% during the Internet crash period. As their name implies, they were in the satellite radio business. Biolase Technology stock dropped 58.9% during the expanded crash period. They manufactured dental laser systems. Bioject Medical stock declined 66.4% during the expanded crash period. They were developing needle-free drug delivery technologies. Valence Technology was engaged in the commercialization of phosphate-based lithium ion rechargeable batteries. Their stock declined 62.1% over the Internet crash period. Fuelcell Energy was developing a process for more efficient production of high-energy fuel cells for electric power generation. Their stock price dropped 57.4% over the 5 weeks of the Internet stock crash. While these stocks crashed along with the Internet sector, none of their businesses were related to or affected by the Internet. And there are many, many other examples.

The last four rows of the table report returns for other industries. Returns for three low-tech industries, banking, oil and gas, and construction materials, are much closer to zero. All stocks in all the other industries had average returns of −5.35% for the expanded crash period and −7.52% for the one-week crash period.

Table VI provides a further cross-sectional examination of the determinant of returns for all stocks during the crash period. In the first regression, the dependent variable is the stocks' return over the expanded crash period while the regressors include dummies for each of the Fama-French industries,[8] a dummy variable for Internet firms, a dummy that takes a value of one if the firm paid a cash dividend in the year prior to March 13, 2000, a dummy for Nasdaq listing, and dummy variables for whether the firm was among the largest or smallest quartile of all NYSE/Amex and Nasdaq stocks on March 13, 2000.

The regression results show that there were economically large cross-sectional differences in stock returns during the expanded crash period, and that differences correspond roughly to much lower returns for growth stocks. Dividend-paying stocks, defined as those that had paid a cash dividend during the previous 12 months, realized returns that were 14.84% greater than others during the expanded crash period. Nasdaq stocks had returns that were 11.73% lower, all else equal, over the period. Clearly, growth firms in general and not just Internet stocks performed poorly during the crash period. Coefficients for four of the industry dummies are reported in the table. Even after adjustment for dividend payment, Nasdaq listing, and firm size, Internet stocks underperformed by 45.12%, pharmaceuticals underperformed by 31.65%, and computer

[8] The industry without a dummy variable is banking. Banking was chosen because of the large number of firms in this category (821) and because returns were close to zero for the expanded crash period.

Table VI

Determinants of Stock Returns over the Internet Crash Period

Cumulative returns are calculated for every CRSP stock for the periods March 13, 2000, through April 17, 2000, and April 10, 2000, through April 14, 2000. Cross-sectional regressions of stock returns on firm characteristics are then run. Book values for the end of the 1999 fiscal year are obtained from Compustat. Market values are as of March 13, 2000. Growth (value) firms are the firms in the lowest (highest) quartile of book-to-market ratios. The dividend dummy takes a value of one if the firm paid a dividend in the previous year and zero otherwise. Profitable is a dummy variable equal to one if the firm earned a positive profit for the year 1999. Robust t-statistics are shown in parentheses under the coefficients.

	Returns 3/13–4/17		Returns 4/10–4/14	
Intercept	−0.0231	−0.1224	−0.0524	−0.0943
	(−2.06)	(−7.69)	(−9.16)	(−11.47)
Dividend dummy	0.1484	0.1002	0.0778	0.0535
	(21.35)	(13.89)	(22.10)	(15.27)
Small firm quartile	0.0101	0.0036	0.0369	0.0291
	(1.42)	(0.50)	(9.51)	(7.48)
Large firm quartile	0.0342	0.0467	−0.0281	−0.0170
	(5.03)	(6.84)	(−7.60)	(−4.63)
Nasdaq dummy	−0.1173	−0.0925	−0.0624	−0.0460
	(−16.98)	(−13.65)	(−17.18)	(−12.92)
Profitable dummy		0.1219		0.0480
		(16.44)		(12.01)
Growth firm dummy		−0.1186		−0.0834
		(−13.08)		(−16.25)
Value firm dummy		0.0123		0.0101
		(1.46)		(2.40)
Internet firm dummy	−0.4512	−0.3069	−0.2325	−0.1522
	(−34.41)	(−18.68)	(−27.11)	(−14.96)
Pharmaceuticals dummy	−0.3165	−0.1870	−0.1352	−0.0592
	(−20.90)	(−10.95)	(−14.97)	(−6.05)
Medical equipment dummy	−0.1631	−0.0819	−0.0675	−0.0211
	(−8.78)	(−4.10)	(−6.45)	(−1.89)
Computer dummy	−0.2661	−0.1825	−0.1512	−0.1025
	(−14.79)	(−9.05)	(−13.33)	(−8.69)
Other industry dummies	Yes	Yes	Yes	Yes
Ind. dummies significant at 1%	20	12	20	13
Observations	6,593	5,981	6,593	5,981
R^2	0.4577	0.5215	0.4371	0.5088

stocks underperformed by 26.61%. This could reflect the high average betas of stocks in these industries.

Because the CRSP value-weighted index outperformed the CRSP equal-weighted index over the crash period, it would seem that large firms should have outperformed small ones. The coefficient on the dummy variable for inclusion in the largest quartile of stocks is only 3.42% though. It appears that much of the difference in returns between equal and value-weighted indices over this period can be attributed to dividend payment or Nasdaq listing.

The regression reported in the next column includes three additional variables derived from Compustat data. The dummy variable for profitable firms is

one if 1999 earnings (Compustat variable 58) were positive when extraordinary items were excluded. A book-to-market ratio for each firm was calculated using the market value on March 13, 2000, and the book value (Compustat variable 6) at the end of the 1999 fiscal year. The growth firm dummy is set to one for the firms in the bottom quartile of book-to-market ratios. The value firm dummy is set to one for firms in the top quartile of book-to-market ratios. Compustat data for 1999 are not available for all firms, so the sample size shrinks from 6,593 to 5,981 stocks.

The R^2 indicates that 52.15% of the cross-sectional variance in stock returns is explained by the regression. The dummy variable for dividend payers remains highly significant statistically. It is also economically significant: Companies that paid a dividend in the prior year had returns that were 10% higher during the expanded crash period all else equal. Firms that were profitable had returns that were 12.19% higher. Growth firms had returns that were 11.86% less all else equal. The crash of Internet stocks in 2000 seems to be part of a larger crash of growth stocks. It is true that even after inclusion of these financial variables, dummy variables for Internet, pharmaceuticals, medical equipment, and computer firms remain economically and statistically negative. Again, this could reflect high betas for stocks in these industries.

The next two columns report results for similar regressions that have cumulative returns over the one-week crash period as their dependent variable. As is true for the entire crash period, dividend-paying firms and profitable firms performed much better over this time period while growth firms performed particularly poorly. Although most of the decline in Internet stock prices is explained by these other variables, the dummy on Internet firms remains negative and significant, as do the dummy variables for high tech industries. The 1-week collapse of Internet stocks was part of a larger crash of growth and high-tech stocks.

E. Equity Offerings and the Internet Stock Crash

Lockup 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 stocks' 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 possibility, 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 lockup expiration regressions because the dollar amounts are not really comparable. If $100 million worth of stock is unlocked on a given day, $100 million worth of stock can be sold in the future. In contrast, if $100 million worth of stock is sold in an SEO, $100 million worth of new stock enters the public float that day.

The time-series regression estimates are reported in Table VII. I report regression estimates for two periods: February 1996 through December 2000, and

Table VII

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. The sample is obtained from Jay Ritter's Web site http://bear.cba.ufl.edu/ritter/. $R_t^{EWNoDiv}$ is the return of an equal-weighted portfolio of all non-Internet non-dividend-paying Nasdaq stocks that traded prior to 1996. Offers are defined as the number of IPOs and SEOs that took place on a particular day. The dollar values of offers are the sum, across all IPOs and SEOs that day, of the global proceeds from SDC. Robust t-statistics are reported in parentheses under the coefficients.

Period	Intercept	$R_t^{EWNoDiv}$	Offers	Value of Offers ($billions)	Log of Offer Values	Number Lockup Expirations	Last 6 Days' Lockup Expirations	Adjusted R^2
1996–2000	−0.0010	1.90	−0.0008					0.5763
	(−1.81)	(37.21)	(−1.81)					
1996–2000	−0.0011	1.90		−0.0039				0.5763
	(−2.15)	(37.26)		(−1.50)				
1996–2000	−0.0018	1.90			−0.00022			0.5766
	(−3.00)	(32.25)			(−1.69)			
1999–2000	−0.0027	2.08	−0.0005					0.6613
	(−2.53)	(32.22)	(−0.96)					
1999–2000	−0.0030	2.08		−0.0023				0.6612
	(−3.11)	(32.43)		(−0.78)				
1999–2000	−0.0032	2.08			−0.00025			0.6621
	(−3.78)	(32.64)			(−1.39)			
1996–2000	−0.0003	1.90	−0.0004			0.0004	−0.0005	0.5786
	(−0.48)	(37.04)	(−0.84)			(0.63)	(−2.66)	

January 1999 through December 2000. The results are very similar when regressions are estimated over 1998 through 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. Thus there is no reliable evidence that equity offerings depressed 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. That is, more offerings are associated with *higher* returns during the crash.[9] I also estimate these regressions using the return on the equal-weighted portfolio of all non-Internet stocks, and the coefficients on the offering variables are even less significant. When I use the value, logarithm of the value, or number of offerings over the prior six days, the results are even weaker.

The last row of the table reports a regression of daily 1996 through 2000 Internet portfolio returns on the number of offers that day, as well as the number of lockup expirations that day and the last 6 days. The number of offers is closer to statistical significance in the regression that is estimated over 1996 through 2000 than in regressions estimated over other periods. It is also closer to conventional levels of statistical significance than the other equity offering variables. When I include number of offers in a regression with the number of lockup expirations, however, the t-statistic is only -0.84. If we were to use this statistically insignificant variable to estimate the impact of equity offerings on Internet stock prices during the expanded crash period, we would find that the impact is small. There were a total of 36 offerings, implying a total impact on prices of $-0.0004 \times 36 = -1.44\%$. In contrast there were 39 lockup expirations, and the total number of lockups over a 6-day period was 227. The total impact from lockup expirations was thus $0.0004 \times 39 - 0.0005 \times 227 = -9.79\%$. Of course, both of these back-of-the-envelope calculations ignore compounding. Since returns to Internet stocks were negative over the crash period, compounding would reduce the total impact of both lockup expirations and equity offerings.

F. Interpreting the Results: Did an Increase in Publicly Available Shares Lead to the Collapse of Internet Stock Prices?

Internet stocks with lockups in effect fell as dramatically as other Internet stocks during the crash. Hence, we cannot say that Internet stocks crashed because prices of stocks were sensitive to the supply of their *own* shares, and that lockup expirations increased the supply of shares for many individual Internet stocks. It is possible that prices of all Internet stocks collapsed when the shares of a few increased because they were regarded by investors as substitutes. They

[9] When offerings over the past 6 days are included in the regression, both the number of offerings over 6 days and the number the same day are insignificant.

would have to be regarded as very close substitutes since the returns of stocks with lockups in effect were almost exactly the same as the returns of stocks with expiring lockups during the crash period.

Although stock prices fall when shares in the company are unlocked, it is clear from Tables IV and VII that contemporaneous lockup expirations and equity offerings only explain a small fraction of the returns of Internet stocks during the crash period. It is still possible for increases in the supply of shares after lockup expirations to cause a collapse in prices. Unlocked shares are usually sold over time. Sales of previously unlocked shares could have depressed prices in March and April 2000.

This seems implausible though. The collapse of Internet stock prices, particularly during the week of April 10 through April 14, 2000, was abrupt. The market had absorbed billions of dollars worth of shares of Internet stocks in January and February while Internet stock prices rose. Did the rate at which Internet shares were sold to the public suddenly increase? The number of lockup expirations could proxy for an increase in the rate of sales to the public, but, as we have seen, contemporary lockup expirations explain little of the Internet stock price collapse. Also, trading volume was not unusually high during the crash period. The average daily dollar value of shares traded for Internet stocks was $21.0 billion in December 1999, $24.6 billion in January 2000, $21.4 billion in February 2000, and $23.3 billion during the expanded crash period. Shares of the average Internet stock turned over at an average rate of 2.3% in December 1999, 1.95% in January 2000, 1.98% in February 2000, and only 1.78% during the expanded crash period. Even during the week of April 10 through April 14, 2000, when Internet stock prices declined by 35%, daily turnover averaged only 1.81%.

An alternative explanation is that the cumulative shares sold to the public over the preceding weeks brought about the collapse of Internet stocks. According to this point of view, the market absorbed billions of dollars of Internet stocks with no apparent impact on prices, but reached a point at which it had little capacity to absorb even a few more shares. I refer to this as the "straw that broke the camel's back hypothesis," or the "kinked demand curve hypothesis." This story holds that the supply of shares, which had been shifting along an elastic demand curve, suddenly found itself on a very inelastic portion of the demand curve. While I cannot disprove the hypothesis, a kinked demand curve seems implausible. In addition, for this story to hold, the inelastic portion of the demand curve for growth stocks of all kinds, not just Internet stocks, must have been reached in March and April 2000.

It is interesting that the returns of Internet stocks during the crash period are mostly explained by the return of an equal-weighted index of non-Internet stocks. It is possible that the crash in Internet stocks and the simultaneous decline in other growth stocks was brought about by a broad change in expectations, sentiment, or risk aversion. It is also possible, if Internet stocks were sufficiently close substitutes for other growth stocks, that the increase in Internet stock shares from lockup expirations caused a broad decline in growth stocks. This implies, of course, that the market for growth stocks in general,

not just the market for Internet stocks, was not deep enough or liquid enough to absorb the extra supply of shares. In addition, if these other stocks were seen as good substitutes for Internet stocks, Ofek and Richardson's assertion that Internet stock prices were high because investors could not short them is called into question. Many of these other stocks were easily shorted in 1999 and 2000.

IV. Summary and Conclusions

After generating returns of over 2,200% in less than 4 years, Internet stock prices peaked in March 2000. They then lost over $700 billion in market capitalization over the next 5 weeks, culminating in a return of −37.3% for the week of April 10 through April 14, 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 lockup expirations and equity offerings. This has led several observers to suggest that the collapse of Internet stock prices is likely to have been caused by the increase in the supply of shares.

This paper's findings cast doubt on the suggestion that increases in the public float of Internet stocks brought about the collapse of Internet share prices. When the market for Internet stocks collapsed, the stocks that were restricted to a fixed supply of shares by lockup 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 an 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 not much affected by the number of contemporaneous lockup expirations. Likewise, the performance of an 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.

Contemporaneous lockup expirations and equity offerings do not explain the collapse of Internet stocks, but much of it does seem to be explained by the returns of the market as a whole. Internet stocks were high-beta stocks, and most of their price decline in March and April 2000 can be explained by a sharp drop in equal-weighted market indices. Other growth stocks, even those in unrelated industries like pharmaceuticals or medical equipment, also suffered substantial losses in March and April 2000.

The results of this paper 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 could say that the high prices of Internet stocks in 1999 and early 2000 were the result of a small supply of shares. The conclusion of this paper that the collapse of prices was not brought about by an increase in the supply of shares suggests, however, that prices of Internet stocks were high for other reasons. Unfortunately, this paper does not identify the other reasons. It is easy to show that current explanations for the

collapse of Internet stocks are incomplete. But, in this case as in others, it is difficult to explain stock price changes even after the fact. I leave the difficult task of explaining the collapse of Internet stocks for future work.

REFERENCES

Battalio, Robert, and Paul Schultz, 2006, Options and the bubble, *Journal of Finance* 61, 2071–2102.

Cochrane, John, 2003, Stocks as money: Convenience yield and the tech-stock bubble, in William C. Hunter, George G. Kaufman, and Michael Pomerleano, eds.: *Asset Price Bubbles* (MIT Press, Cambridge, MA).

Fama, Eugene, and Kenneth French, 1997, Industry costs of equity, *Journal of Financial Economics* 43, 153–193.

Fields, Laura, and Gordon Hanka, 2001, The expiration of IPO share lockups, *Journal of Finance* 56, 471–500.

Greenwood, Robin, 2005, Short-and long-term demand curves for stocks: Theory and evidence on the dynamics of arbitrage, *Journal of Financial Economics* 75, 607–649.

Hao, Qing, 2007, Laddering in initial public offerings, *Journal of Financial Economics* 85, 102–122.

Harris, Lawrence, and Eitan Gurel, 1986, Price and volume effects associated with changes in the S&P 500: New evidence for the existence of price pressures, *Journal of Finance* 41, 815–829.

Hong, Harrison, José Scheinkman, and Wei Xiong, 2006, Asset float and speculative bubbles, *Journal of Finance* 61, 1073–1117.

Lynch, Anthony, and Richard Mendenhall, 1997, New evidence on stock price effects associated with changes in the S&P 500 index, *Journal of Business* 70, 351–383.

Ofek, Eli, and Matthew Richardson, 2003, DotCom mania: The rise and fall of Internet stock prices, *Journal of Finance* 58, 1113–1137.

Purnanandam, Amiyatosh, Rajesh Aggarwal, and Guojun Wu, 2006, Underwriter manipulation in IPOs, Working paper, University of Houston.

Shleifer, Andrei, 1986, Do demand curves for stocks slope down? *Journal of Finance* 41, 579–590.

Wurgler, Jeffrey, and Ekaterina Zhuravskaya, 2002, Does arbitrage flatten demand curves for stocks? *Journal of Business* 75, 583–608.