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DotCom Mania: The Rise and Fall of Internet Stock Prices

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ABSTRACT

This paper explores a model based on agents with heterogenous beliefs facing short sales restrictions, and its explanation for the rise, persistence, and eventual fall of Internet stock prices. First, we document substantial short sale restrictions for Internet stocks. Second, using data on Internet holdings and block trades, we show a link between heterogeneity and price effects for Internet stocks. Third, arguing that lockup expirations are a loosening of the short sale constraint, we document average, long-run excess returns as low as −33 percent for Internet stocks postlockup. We link the Internet bubble burst to the unprecedented level of lockup expirations and insider selling.

IN THE TWO-YEAR PERIOD from early 1998 through February 2000, the Internet sector earned over 1000 percent returns on its public equity. In fact, by this date, the Internet sector equaled 6 percent of the market capitalization of all U.S. public companies and 20 percent of all publicly traded equity volume. As is well documented, however, these returns had completely disappeared by the end of 2000. What can explain this rise, persistence, and then subsequent fall of Internet stock prices? This paper provides empirical support for one potential explanation that has garnered recent attention in the literature.

In particular, there is a considerable and growing literature that looks at the impact of short sales restrictions on stock prices in a setting with heterogenous investors (see, e.g., Lintner (1969), Miller (1977), Figlewski (1981), Jarrow (1981), Diether, Malloy, and Scherbina (2002), Ofek and Richardson (2001), Chen, Hong, and Stein (2002), Duffie, Garleanu, and Pedersen (2002), and Jones and Lamont (2002), among others). In these models, asset prices are a weighted average of beliefs about asset payoffs. While the asset prices are equilibrium determined to the extent that they reflect the underlying beliefs about payoffs, short sales restrictions force the pessimistic investors out of the market, leaving only optimistic investors and thus inflated asset price levels.

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There are two important elements for this explanation. The first is the existence of relevant short sales restrictions for Internet stocks. This is important because there must be a reason why well-funded, pessimistic investors do not push Internet prices back to reasonable levels. The second is that there is sufficient heterogeneity across investors such that the marginal investor might look very different from one period to the next. In particular, prices can move substantially as "conditions" arise for either optimistic or pessimistic investors to enter the market. This paper provides supporting evidence for these elements as it pertains to the market for Internet stocks. Moreover, this evidence leads to a cohesive story for why Internet prices eventually fell in the presence of short sales restrictions.

First, we document that even though there might have been plenty of capital available for rational trading, the market had limited ability to short Internet stocks. Specifically, we present evidence of higher short interest for Internet firms, higher borrowing costs for shorting Internet firms, and greater violations of put call parity for Internet firms in the options market, which necessarily implies short sales constraints. Second, in documenting heterogeneity across investors, we show that the level of institutional holdings in Internet stocks is significantly lower than it is for a sample of control firms. Given the growing research in finance on the differences between institutional and retail traders in terms of the "rationality" of their beliefs (e.g., Barber and Odean (2000, 2001) and Shiller and Pound (1989)), this evidence is consistent with our story for the "Internet bubble." As further evidence, we look at IPO-related events in which there is theoretically a shift towards retail investors. The evidence shows that, in these periods, volume is higher, block trading levels (our proxy for institutional trading) decrease, and Internet prices rise dramatically. For example, the median return on the first day of the IPO for Internet stocks is 125.4 percent when block trading levels are low versus only 27.1 percent when levels are high.

As an application, we provide a detailed analysis of the impact lockup expirations have on Internet stock prices. Because lockup agreements represent the most stringent form of short sales constraint (i.e., the investor cannot sell the share), lockup expirations are equivalent to loosening of this constraint. Moreover, since almost by construction these investors represent less optimistic investors, the strong negative short- and long-run permanent price responses provide strong support for this paper's thesis. For example, conditional on the lockup end, Internet stock prices fall by as much as 33 percent over a six-month period relative to the index. While at first glance, one might expect the lockup expiration to produce an immediate effect, we argue that it takes time for investors to sell and their beliefs to get incorporated in prices. As an illustration of this, we show that insider sales, both in number and dollar terms, remain persistent in the postlockup period. Furthermore, conditional on an insider sale, Internet stock prices drop. This drop is consistent with these investors having pessimistic beliefs under short sales constraints.

Of particular interest, the results also suggest a cohesive story for why the Internet bubble did eventually burst. During the spring and latter half of 2000, an extraordinary number of lockups expired. Though there is evidence that the constraint against shorting these stocks was binding, these lockup expirations added a significant number of new investors to the market. If a fraction of these investors were either agnostic or pessimistic, then these "realistic" beliefs would get incorporated into asset prices. In fact, we document that a significant number of new shares were sold during this period, either through insiders via lockup expirations or by the firms via seasoned equity issues. If the negative price fall for all of these stocks had an effect on the "bubblelike" beliefs of the optimistic investors (as in most rational bubble explanations), then the Internet stock market itself could follow suit and fall.

This paper is organized as follows. In Section I, we describe the data used in this study. Section II documents the two key elements of the Internet pricing explanation: (a) short sales restrictions for the Internet versus non-Internet sector, and (b) evidence of heterogeneity among investors in the Internet versus non-Internet sector, in our case, via institutional ownership and trading. Section III focuses on an event which substantially relaxes the short sales constraint, namely, the end of the lockup period, and provides evidence of corresponding declines in stock prices. Section IV ties the burst of the Internet bubble to coincident lockup expirations of Internet stocks. Section V concludes.

I. The Data

This paper studies various characteristics of Internet-related companies over the period January 1, 1998, to February 29, 2000. There is no strict definition of what constitutes an Internet-related firm, as a number of firms, especially in the technology sector, could perform both "old economy" and Internet-related functions. For the past few years, Morgan Stanley has published a list of Internet companies.[1] For want of a better definition, we follow their breakdown, which yields a total of 400 companies in pure Internet-related sectors.

Figure 1 graphs the index of an equally weighted portfolio of the Internet stocks over the sample period January 1998 to December 2000 versus the S&P 500 and Nasdaq indices over this same period. While this graph is not evidence of mispricing per se, there is the widely held view that there was a divergence between the relative pricing of Internet stocks and the broad market as a whole during this period.[2]

Table I provides some descriptive statistics about this sample of Internet firms versus the universe of firms. Several observations are of interest. First, the price characteristics, bid–ask spreads, and market value of this sample of firms suggest that there is nothing unusual about the Internet sector that could explain the

[1] The criteria for a company to be included is that it must be considered a pure Internet company. This means that technology companies like Cisco, Microsoft, and telecommunication firms, with extensive Internet-related businesses, are excluded.

[2] For example, using the framework of Miller and Modigliani (1961) and French and Poterba (1991), Ofek and Richardson (2002) show that Internet stocks' implied earnings would have to grow at rates multiple-fold those of the ex post two percent highest growth firms over the last 40 years (e.g., as documented in Chan, Karceski, and Lakonishok (2001)).

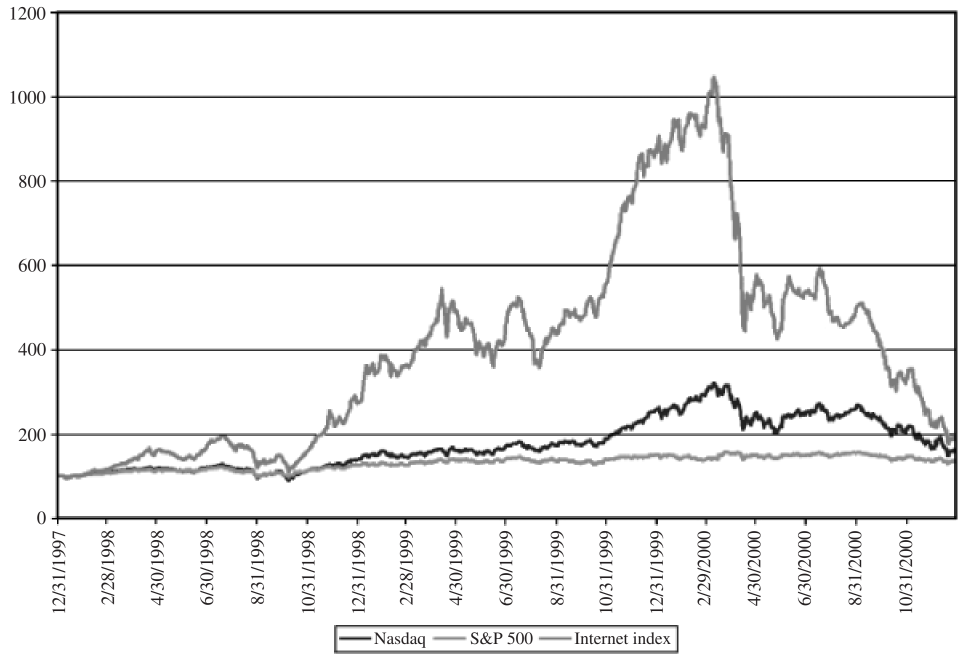

Figure 1. Returns on equally weighted Internet index, S&P 500 and Nasdaq composite. Comparison of index levels of the equally weighted Internet index, the S&P 500 index, and the Nasdaq composite index for the period 1/1/1998–12/31/2000. All three indexes are scaled to be 100 on 12/31/1997.

difference in stock price behavior compared to non-Internet stocks. Second, both the ex post mean and volatility were extremely high during the period for the Internet versus non-Internet sample. Third, Table I reports both the median daily volume and share turnover for these firms. These measures suggest an active, liquid market for the Internet stocks during the sample. In fact, relative to the universe of firms, the average volume per stock is three times higher for Internet firms. The magnitude of this volume is even more surprising given that a significant number of shares were not allowed to trade during the lockup period following these firms' IPOs. In addition, depending on the metric, share turnover is between two to four times higher for Internet firms.

II. Short Sales Constraints and Heterogeneity of Investors

The introduction of this paper suggests a story for the Internet bubble. On the one hand, there were many optimistic investors arriving to the market willing to pay high prices for Internet stocks; on the other hand, some pessimistic investors were willing to short these stocks at the high prices. However, because the amount of shorting is limited in practice, the pessimistic investors' beliefs got overwhelmed by the optimistic beliefs, leading to the high valuation of Internet stocks.

Table I

Sample Description

Descriptive statistics of a sample of 320 Internet firms and 3,861 non-Internet firms as of 2/29/2000. Average daily return is for the period 1/1998 to 2/2000. The information for Internet firms is reported for the whole subsample and for 267 Internet firms with price > $10 on that date.

Variable	Internet	Sample	Mean	Median	STD	Low	High
Market value of equity ($ mil)	No	$P > 10$	5,111	599	22,248	1	461,177
	Yes	$P > 10$	4,495	1,323	11,131	48	131,755
	Yes	All	3,801	977	10,294	20	131,755
Stock price	No	$P > 10$	33.97	22.00	39.61	5.38	1,100.00
	Yes	$P > 10$	65.96	46.38	62.56	9.56	322.44
	Yes	All	56.23	35.06	61.19	2.50	322.44
Bid ask spread/mid price	No	$P > 10$	0.013	0.008	0.031	0.000	1.645
	Yes	$P > 10$	0.007	0.005	0.007	0.000	0.058
	Diff		– 0.006[a]	– 0.002[a]			
Bid ask spread $	No	$P > 10$	0.610	0.188	16.250	0.000	1,000
	Yes	$P > 10$	0.348	0.188	0.411	0.063	3
	Diff		– 0.261	0.000			
Median daily volume previous 100 days ($ mil)	No	$P > 10$	24,988	2,321	128,355	1	3,392,355
	Yes	$P > 10$	78,558	16,419	169,774	1,023	1,204,647
	Yes	All	66,757	12,888	158,250	1	1,204,647
Median shares-turnover previous 100 days	No	$P > 10$	0.0078	0.0034	0.0140	0.0000	0.3554
	Yes	$P > 10$	0.0148	0.0125	0.0097	0.0011	0.0519
	Yes	All	0.0146	0.0125	0.0094	0.0011	0.0519
Average daily return	No	$P > 10$	0.0019	0.0005	0.0046	– 0.0291	0.0627
	Yes	$P > 10$	0.0067	0.0060	0.0074	– 0.0120	0.0375
Daily standard deviation of return	No		0.0350	0.0300	0.0203	0.0034	0.3952
	Yes		0.0742	0.0728	0.0218	0.0135	0.2078
	Diff		0.0392[a]	0.0428[a]			

[a]Significant at the one percent level.

A. Short Sales

If one takes the view that there are considerable amounts of "rational" capital in the marketplace, the question remains, why was the capital not deployed against the Internet sector? There are two possible reasons why pessimistic investors did not short stocks sufficiently to offset the optimistic investors: Either investors were unwilling or could not short stock (at least up to some point). With respect to the former reason, Chen et al. (2002), among others, argue and cite evidence that mutual funds are reluctant to short stocks. Moreover, Shleifer and Vishny (1997) argue that hedge funds may avoid risk-adjusted excess return trades (e.g., shorting overvalued Internet stocks) in highly volatile settings. The stylized facts of Table II suggest that Internet stocks were much more volatile than other stocks during this period.[3] Thus, a large amount of capital may have been unwilling to short Internet stocks. With respect to the latter reason, there is growing evidence in the finance literature that there are periods in which short sales constraints bind (e.g., see Gezcy, Musto, and Reed (2001), D'Avolio (2002), Jones and Lamont (2002), and Mitchell, Pulvino, and Stafford (2002), among others).

With respect to the Internet sector, Table II, Panel A, reports the amount of short interest relative to the universe of stocks in February 2000. Short interest here is defined as the total amount of shares of stock that have been sold short relative to the total amount of shares outstanding. As seen in the table, short interest was considerably higher for Internet stocks than for their corresponding old economy counterparts. For example, the short interest measures are 2.8 percent versus 1.8 percent for the mean and 1.6 percent versus 0.7 percent for the median, respectively. In addition, across the distribution of short interest in the universe of stocks, the 90th and 95th percentiles are considerably larger for the Internet sample (i.e., 6.9 percent and 10.6 percent versus 4.7 percent and 7.8 percent, respectively). However, the fact that Internet stocks were substantially more short relative to old economy stocks does not necessarily mean Internet stocks were at a saturation point in terms of the ability to short more.

To gather additional evidence, we collected proprietary rebate rates for the universe of stocks on a selected number of dates from a financial institution, in particular, one of the largest dealer–brokers.[4] Table II, Panel A, documents these

[3] On the other hand, while this arbitrage is risky, a diversified portfolio across all assets would expose the trader to only the systematic risk of Internet stocks.

[4] When an investor shorts a stock (i.e., the borrower), he must place a cash deposit equal to the proceeds of the shorted stock. That deposit carries an interest rate referred to as the rebate rate. When there is an ample supply of shares to short, the rebate closely reflects the prevailing interest rate. However, when the supply is tight, the rebate rate will be lower. This lower rate reflects compensation to the lender of the stock at the expense of the borrower, and thus can provide a mechanism for evening out demand and supply in the market. However, along with receiving a lower rate on their cash proceeds, the short investors (a) may also face a higher risk of having their shorts called, and (b) there is no guarantee one can find a substantial amount of stock to short at these rates. (See D'Avolio (2002), Gezcy et al. (2002), Jones and Lamont (2002), and Mitchell et al. (2002) for a discussion of these issues, albeit not for Internet stocks.)

Table II

Short Interest and Rebate Rates for Internet Firms

Panel A provides a comparison of various measures of short interest between 273 Internet firms and 3,946 non-Internet firms with stock prices greater than $10. Short interest data and the rebate rates are as of February 2000. The last two columns provide the 5% (95%) and 10% (90%) tails of the distribution for the rebate rate (short interest) respectively. The put call parity violations are for a sample of 9026 options pairs days. There are 114 Internet stocks and 890 non-Internet firms in the sample. The option prices are from three separate days in February 2000. The violation measure is set to one if stock price in the stock market is above its theoretical price from put call parity adjusted for transactions costs in the options market, and zero otherwise. The implied stock price equals to call ask price − (put bid price − American put premium) + PV(strike price). Panel B provides a correlation between various measures of short interest and firm characteristics for 273 Internet firms as of February 2000. Put call parity violations is the average number of PCP violations per firm. Implied P/E is the stock price scaled by steady state earnings (current revenues × profit margins of comparable old economy margins).

Panel A: Measures of Short Sales Restrictions

	Internet	Mean	Median	STD	p10/p90	p5/p95
Short interest/shares outstanding	No	0.018	0.007	0.034	0.047	0.078
Short interest/shares outstanding	Yes	0.028	0.016	0.034	0.069	0.106
	Diff	− 0.010[a]	− 0.009[a]			
Rebate rate on shorts %	No	5.407	5.660	1.034	5.080	3.590
Rebate rate on shorts %	Yes	4.328	5.210	1.952	0.870	0.040
	Diff	1.078[a]	0.450[a]			
Violations of put call parity after TC	No	23.8%				
	Yes	36.0%				
	Diff	12.2%[a]				

Panel B: Correlation Between Short Sales Restrictions and Valuation Measure

	Short interest/ shares outstanding	Rebate rate	PCP violations	Implied PE
Short interest/shares outstanding	1.000	− 0.431	0.076	− 0.045
Rebate rate on shorts %	− 0.431	1.000	− 0.203	− 0.161
Put call parity violations	0.076	− 0.203	1.000	0.120
Implied PE	− 0.045	− 0.161	0.120	1.000

[a]Significant at the one percent level.
[b]Significant at the five percent level.

rebate rates across Internet stocks versus non-Internet stocks. The mean and median rebate rate is, respectively, 1.08 percent and 1.45 percent less for Internet stocks than other stocks, and these differences are statistically significant. Motivated by the view described in footnote 4 that the rebate rate maps one-to-one with the difficulty in shorting (rather than representing the actual cost of shorting), Table II, Panel A, provides a comparison of the tails of the distribution of rebate rates across the two samples. Note that 46 percent of the Internet stocks lie in the 10 percent tail of all rebate rates. In fact, the mean rebate rate on Internet stocks would represent the eighth percentile of the non-Internet distribution. Thus, the evidence supports the proposition that relatively more Internet stocks had reached a limit in their short positions.

Another way to gather evidence on whether short sales constraints bind is via the options market. In particular, if the put–call parity restriction for options fails, then it necessarily must be the case that two conditions are met (e.g., Cox and Rubinstein (1985)): (a) One cannot sell securities short, and (b) the options and equity market are segmented such that investors choose to hold the stock even though there exists a portfolio (e.g., a bond, a call on the stock, and short a put on the stock) that provides a higher return in all possible circumstances (see, e.g., Figlewski and Webb (1993), Lamont and Thaler (2000), and Ofek, Richardson, and Whitelaw (2002)). For three days in February 2000, we collected data on option pairs (i.e., calls and puts with the same strike price) across the universe of stocks.[5] For each of these pairs, we calculate the implied stock price from put–call parity, that is, a call minus a put plus the present value of the strike price. Because American put options have a value to early exercise, we also added back an estimate of the early exercise premium. Table II, Panel A, documents whether there exist differences between the Internet versus non-Internet sector adjusted for transactions costs, that is, buying (selling) the call at its ask (bid) and selling (buying) the put at its bid (ask) to replicate a long (short) position in the stock. For Internet firms, 36 percent of the options pairs violate the bound while only 23.8 percent of the non-Internet sample does. These results are significant at the one percent level and suggest that the Internet sample suffers from many more arbitrage violations, which necessarily implies that Internet stocks were more short-sales constrained.

As a final analysis, Table II, Panel B, provides additional evidence on the relation between the various measures of short-sales constraints. First, Table II, Panel B, documents the correlation between short interest, the rebate rate, and option arbitrage violation. As one might expect, the correlation is significant and negative. That is, the higher the short interest, the lower the rebate rate, the more likely to violate put–call parity, and presumably the more difficult to find a significant number of shares to short sell. Second, Table II, Panel B, provides the cross-sectional correlation between the implied P/E ratios of each stock and these measures.[6] For example, if a higher implied P/E signals a more overvalued Internet stock, then the rebate rate should be lower, as short selling will be at its saturation point from the trading of pessimistic investors. As expected, the correlation is significant at the one percent level and economically meaningful, that is, −0.16. Similar correlation patterns carry through for the other measures.

[5] To restrict ourselves to liquid options, the sample uses at-the-money options with maturities greater than 30 days with positive open interest of non-dividend-paying firms. This filter leads to 7,515 option pairs for 890 non-Internet stocks and 1,511 pairs for 114 Internet stocks.

[6] The implied P/E ratio is calculated using the firms' revenues and assuming that the firm's long-run income margins reflect those of their counterpart industry from the old economy.

B. Heterogeneity

To show heterogeneity among investors, we need to determine which investors were holding Internet stocks versus non-Internet stocks. There is evidence that there was much greater volume in Internet-related than in non-Internet equity markets (see Table I). Table III, Panel A, documents that, on a relative basis compared to non-Internet stocks, these participants were retail investors rather than institutions. For example, in March 2000, the median holding of institutions for Internet stocks was only 25.9 percent versus 40.2 percent for non-Internet stocks. These differences are strongly significant from a statistical point of view. While these differences drop if the sample is restricted solely to IPOs (i.e., from 15.1 percent to 7.4 percent), they are still significant statistically. The differences here are most probably understated. An investigation of Morningstar's database for this period shows that a number of Internet-based mutual funds started in 1999 and early 2000. Though these are measured as institutional holdings, it is clear that the funds themselves are simply pass-throughs to retail investors. That is, the creation of Internet mutual funds was not necessarily due to an institutional view of Internet valuations, but more demand-driven from retail investors.

If more retail investors were in the market than under normal conditions, then one might reasonably argue that the market was more prone to the types of behavioral biases that lead to overly optimistic beliefs. Recent work supports this view of retail investors (e.g., Shiller and Pound (1989) and Barber and Odean (2000, 2001)). As complementary evidence of a typical institution's view of the Internet, Table III, Panel B, reports the Internet versus non-Internet holdings of the largest pension funds as of March 2000. Though the Internet weight in the aggregate market is 4.38 percent, the holdings of pension funds are underweighted in the Internet sector, representing only 2.3 percent.[7] This is consistent with Chen et al. (2002), who argue that overvalued firms will have lower breadth of institutional ownership.

There is substantive evidence in the literature and elsewhere that the response of Internet stock prices to event-driven information is large in magnitude relative to non-Internet stocks (e.g., Ofek and Richardson (2001, 2002)). To the extent Internet firms were short sales constrained, can these stock price responses be related to investor heterogeneity, that is, to a shift in investor clienteles? We explore this question by appealing to two events associated with a firm's initial public offering: (a) The first day of trading, and (b) the quiet period end.[8] From a

[7] On the other hand, not all institutions avoided the Internet sector. For example, from the \$136 and \$222 million held in public equities and reported in 13-F filings by University of Chicago and Yale University, 26 percent and 52 percent were respectively invested in our sample of Internet firms.

[8] According to the rules of the SEC, during a 25-day quiet period after the IPO, the underwriters and the company must remain silent with respect to the company's financial prospects. This practically means that the underwriters cannot publish research and that the company cannot give forecasts and must maintain a relatively low public profile (outside of hard news; see, e.g., Bradley, Jordan, and Ritter (2003)).

Table III

Institutional Holdings in Internet Firms

Panel A provides a comparison of various measures of institutional holdings between 273 Internet firms and 3,946 non-Internet firms with stock price greater than $10. The institutional holdings are from the quarter that ended on March 31, 2000. Panel B shows a fraction of the largest pension fund holdings in Internet and non-Internet stocks. These pension funds refer to ones identifiable via their 13-F filings and ranked by *Pensions and Investments Magazine*. The institutional holdings are from the quarter that ended on March 31, 2000. Holdings are in millions.

Panel A: Institutional Ownership

Variable	Internet	Sample	Mean	Median	STD	Low	High
Institutional holdings/shares outstanding	No	P > 10	0.4056	0.4024	0.2571	0.0000	0.9987
	Yes	P > 10	0.3133	0.2592	0.2141	0.0014	0.9851
	Diff		− 0.0923[a]	− 0.1432[a]			
Number of institutions	No	P > 10	110	65	146	1	1219
	Yes	P > 10	76	54	78	1	848
	Diff		− 35[a]	− 11[a]			
Institutional holdings/shares outstanding	No	IPOs	0.3542	0.3148	0.2383	0.0019	0.9856
	Yes	IPOs	0.2953	0.2412	0.2024	0.0014	0.9851
	Diff		− 0.0589[a]	− 0.0736[b]			
Number of institutions	No	IPOs	63	50	55	2	376
	Yes	IPOs	65	50	50	6	322
	Diff		2.0	0.0			

Panel B: Largest Pension Fund's Ownership

Name	Internet Holdings ($)	Non-Internet Holdings ($)	Internet Weight
California Public Employees Retirement System	2,858	79,320	3.48%
New York State Common Retirement Fund	1,194	70,141	1.67%
Teacher Retirement System of Texas	863	61,745	1.38%
California State Teachers' Retirement System	2,201	57,159	3.71%
The Regents of the University of California	539	42,678	1.25%
The State Teachers Retirement System of Ohio	528	32,985	1.58%
State Treasurer State of Michigan	646	32,110	1.97%
The Florida State Board of Administration	998	30,871	3.13%
State of Wisconsin Investment Board	167	13,539	1.22%
IBM Retirement Funds Equity	295	12,446	2.32%
Total holdings by pension funds	10,289	432,994	2.32%
Total market capital	1,107,778	24,164,630	4.38%

[a]Significant at the one percent level.
[b]Significant at the five percent level.

theoretical perspective of measuring shifts in investor clienteles, these events seem to be good candidates. First, with respect to (a), the first day represents the first time the public at large, that is, the typical retail investor, can purchase shares in the company (e.g., Ljungqvist, Nanda, and Singh (2002)). For (b), Bradley et al. (2003, p. 17) argue that quiet-period trading patterns are consistent with "buying on the rumor, and selling on the news"; in particular, smart investors accumulate shares in anticipation of selling them back to less sophisticated investors at the initiation of research coverage at the quiet period end. Second, both (a) and (b) represent significant increases in volume, further suggesting new investor entry into the market (e.g., Bradley et al. (2003, Figure 3)). Third, and finally, both (a) and (b) are associated with large price responses (e.g., see, respectively, Loughran and Ritter (2001) and Bradley et al. (2003)). Moreover, these responses appear to be larger for the sample period in question, 1998 to 2000 (e.g., Ljundqvist and Wilhelm (2002)). While there are other explanations that might fit the data (e.g., consider the extensive literature on IPOs), these papers are consistent with our general story, namely that the combination of short sales constraints (via the IPO) and shift in investor clienteles towards retail investors can lead to an inflated stock price response.

Can the large price moves associated, in particular, with Internet stocks be tied to similar shifts in the marginal investor? To obtain support for this view, we gather evidence on the level of block trading around the aforementioned events. Due to their size and the amount of capital required, block trades tend to represent trades between two institutions, that is, both on the buy and on the sell side (e.g., Lee and Radhakrishna (2000) and Saar (2001)).[9] In contrast, if the trade size is small, then it could be either a buy or a sell by a retail investor or an institution. Thus, on average, a decrease in or a lower level of block trading suggests some shift away from institutional participation in the market on both sides of the transaction. This lowers (albeit noisily) the chance that the institution is the marginal investor.

For these two IPO events, Table IV reports both mean and median returns for Internet stocks under conditions of low versus high levels of block trading. First, the results suggest large differences between returns conditional on levels of block trading. For example, with respect to the IPO's first day, the median and mean returns are, respectively, 125.4 percent and 148.4 percent for low levels versus only 27.1 percent and 44.5 percent for high levels. Similarly, for the quiet period end, the median and mean are 11.7 percent and 20.6 percent versus 6.0 percent and 6.6 percent, respectively. Thus, most of the puzzling high returns are associated with institutions avoiding at least one side of the transaction,

[9] In particular, Lee and Radhakrishna (2000) document that, even though trades often have multiple participants, for trades greater than $100,000 or 1,900 shares, there is only a one percent or three percent probability, respectively, that the trade has retail participants. For our sample of block trades, each trade is a minimum of 10,000 shares. Moreover, following each firm from its IPO date to the end of the quiet period, we find that the average size of a block trade across firms is $494,000 and the median is $313,000. Thus, our block trade data is in the right tail of the Lee and Radhakrishna study and therefore represents supporting evidence of institutional trading.

Table IV

First Day Returns, Quiet Period Return, and Block Trades

Return analysis of first day return and quiet period return for Internet firms. The sample includes 305 Internet IPOs between 1/1998 and 4/2000. CAR is cumulative abnormal return. Daily abnormal return is the difference between the firm on the stock and the Internet index. The block variable is the ratio of block trade (10,000 shares or more) to total trades during the return period.

Sample	Mean Return	Median Return	Observations
First day after IPO return			
All	96.24%[a]	65.83%[a]	293
Block < median	148.38%[a]	125.40%[a]	146
Block > median	44.46%[a]	27.08%[a]	147
Difference	103.91%[a]	98.32%[a]	
Block < 1%	132.31%[a]	109.38%[a]	191
Block > 1%	28.71%[a]	18.75%[a]	102
Difference	103.60%[a]	90.63%[a]	
CAR days −10 to 1 around quite period expiration			
All	13.60%[a]	8.24%[a]	272
Block < Median	20.60%[a]	11.73%[a]	136
Block > Median	6.61%[a]	6.04%[a]	136
Difference	13.99%[a]	5.68%[b]	
Block < 1%	16.10%[a]	10.44%[a]	216
Block > 1%	3.97%	4.63%	56
Difference	12.13%[a]	5.80%[b]	

[a]Significant at the 1 percent level.
[b]Significant at the 10 percent level.

presumably the buy side. Second, these results are not sensitive to using different measures of what constitutes a high versus low level of block trading. That is, in using an absolute rather than a relative measure, we report similar findings, for example, 109.4 percent and 132.3 percent for the median and mean, respectively, for low block trading levels versus 18.8 percent and 28.7 percent for high levels. Third, and not reported in the table, regressions of returns on block trading levels strongly confirm these findings. For example, a one standard deviation decrease in block trading results in a 30.5 percent increase in the IPO first day price, and, similarly, a one standard deviation decrease in block trading levels produces a 6.1 percent increase in Internet share prices during the quiet period.

Our story suggests a potential explanation for financial anomalies in general. Specifically, if stocks are short sales constrained so that beliefs do not necessarily get aggregated, then potential shifts towards optimistic (retail) investors can move prices.[10] Here, the evidence shows that around events with theoretical

[10] Note that this relation is asymmetric in that there are only restrictions on selling short. Thus, if retail investors are overly pessimistic, then their beliefs will not matter as much since the institutional investors can, in theory, continue to purchase shares.

shifts towards retail investors, we empirically observe that institutional investor participation falls (as measured by block trading levels) and stock prices rise. We surmise here that the magnitudes are greater than other anomalies because of both the severity of the short sales constraint and diverse beliefs held by investors for Internet stocks.

III. Short Sales Constraints, Heterogeneity, and Stock Prices: Evidence from the Lockup Period

Consistent with the story of inflated prices due to heterogenous beliefs and binding short sales constraints, Section II above showed that Internet firms were in fact both short sales constrained and were owned relatively more often by retail investors. Furthermore, some well-documented stock price jumps for Internet firms around events could be linked to corresponding shifts in investors. Our confidence in this latter evidence, however, is muted in that we do not have direct evidence, only best guesses, on who was buying or selling shares. Fortunately, we can address this problem by analyzing Internet stock price effects around the end of the lockup period.[11]

Since, upon completion of the lockup period, shareholders are free to sell their existing shares, one can view lockup agreements as a severe form of short sales constraints on the majority of shareholders. Thus, the lockup end represents an event which results in (a) a permanent shift in the amount of available shares in the marketplace (i.e., the removal of substantive short sales constraints), (b) a shift in the class of investors who may have different beliefs than the current marginal investors, and (c) members of this new class are potential sellers (as there has been no symmetric restriction on their buying shares during this period outside of their desire to be diversified). If there is heterogeneity across investors and short sales restrictions, then we would expect a drop in Internet stock prices around the event. In other words, the lockup loosens the binding short sales constraints.

A. Stylized Facts from the Lockup Period

Recently, a number of papers have explored the lockup period (e.g., Bradley et al. (2001), Field and Hanka (2001), Brav and Gompers (2002), and Ofek and Richardson (2000)). These papers all report similar price and volume effects around the end of the lockup period over different time periods. Though not described as a potential explanation in any of these studies, these effects fit our general story of heterogeneity and short sales restrictions. Note that the magnitude of these effects depends on two factors: (a) the degree to which short sales

[11] During an IPO, the existing shareholders (e.g., insiders, venture capitalists, angel investors, etc.) rarely sell the entire company. Instead, approximately 15–20 percent of the shares are issued to the public. Though not a legal requirement, it is a standard arrangement for the underwriters to insist upon the remaining 80–85 percent of shares to be restricted from sale for a certain period of time without the express written consent of the underwriter.

constraints bind, and (b) the heterogeneity of beliefs across investors. As shown in Section II, these factors are especially relevant for Internet firms.

For our sample of Internet firms, Table V, Panel A, reports average daily and cumulative abnormal returns for the Internet IPO sample around the end of the lockup period. The abnormal returns are calculated by taking the firm's return minus the return on the index of Internet stocks. For comparison to existing evidence, several observations are in order. First, around the lockup end (usually chosen as the two-day return -1 to 0), the Internet sample's mean excess return is -2.0 percent versus -1.1 percent in the Ofek and Richardson (2000) and -1.2 percent in the Field and Hanka (2001) non-Internet samples. Over a longer five-day window (from day -4 to 0), these results are even greater, that is, -4.11 percent versus -2.3 percent and -1.6 percent, respectively. The increase in magnitude is consistent with the hypothesis that the price drop is due to less optimistic investors being allowed to sell in the market. Second, there is a large jump in volume at the lockup end, and, though this volume drops thereafter, it remains above the prelockup period. For example, the daily excess volume more than doubles (i.e., 109.3 percent), on average, compared to the period prior to expiration. While this result is the same for non-Internet companies, the magnitude of the volume increase on and after the lockup day is higher than the 35–45 percent previously reported in other studies. This may also be due to the increased number of sellers due to their skepticism about Internet prices. Third, postlockup, there tends to be a gradual drift down in the prices of these firms. For example, over the 10-day postlockup period, excess returns on average drop by an additional -3.3 percent. We hypothesize that this may be due to the gradual shift towards pessimistic investors. This result is important because, consistent with this hypothesis is the fact that this continued drop postlockup is not found in previous studies of lockups for non-Internet firms.

Note that there are two ways "pessimistic beliefs" can get incorporated into stock prices: (a) either through direct selling (as in the lockup restrictions being lifted), or (b) through short selling. To the extent that the lockup end also dramatically increases the number of shares floating, we should also expect corresponding changes in short interest levels. To generate some evidence on this claim, Table V, Panel B, looks at short interest in the Internet sector pre- and postlockup. The short interest is approximately three times higher (and statistically significant) in the postlockup period, which gives support for the Internet sector having an even greater amount of short interest relative to non-Internet stocks. The fact that short interest increases, however, still does not mean that short sales constraints are no longer binding. For example, there may still remain significant numbers of investors who would like to short Internet stocks but find it difficult to do so. Table V, Panel B, shows this to be the case as the distribution of rebate rates is similar both pre- and postlockup.

B. The Long-run Effects of Selling

Around the lockup expiration, we document a consistent decline in Internet stock prices above and beyond the overall move in Internet prices of -3.3 percent

Table V

Excess Returns and Volume around the End of the Lockup Period

In Panel A, the sample includes 305 Internet IPOs between 1/1998 and 4/2000. Window measures the days over which the cumulative excess return and excess volume are measured. Day 0 is the expiration day of the lockup. The excess return is the difference between the firm on the stock and the Internet index. Daily excess volume is the ratio of volume (in shares traded) on that day to average number of shares traded per day in the period -60 to -20 relative to lockup expiration minus 1. Average daily excess volume is the average daily volume during the window period. Panel B shows a comparison of various measures of short interest for the pre- and postlockup periods for Internet firms (from Table II). Short interest data and the rebate rates are as of February 2000. The last two columns provide the 5% (95%) and 10% (90%) tails of the distribution for the rebate rate (short interest) respectively.

Panel A: Excess Returns of Internet Firms Around Lockup End

Window	Cumulative Abnormal Return	*t*-stat	Average Daily Excess Volume	*t*-stat
Days -1 to 0	-1.99%	-2.60	109.28%	6.76
Days -4 to 0	-4.11%	-4.11	56.65%	6.10
Days -10 to 0	-5.34%	-4.36	37.03%	5.26
Days 1 to 10	-3.27%	-1.96	57.44%	5.84

Panel B: Measures of Short Sales Restrictions for Internet Firms Pre- and Postlockup End

	Sample	Mean	Median	STD	p10/p90	p5/p95
Short interest/shares outstanding	Prelockup	0.015	0.007	0.021	0.042	0.058
Short interest/shares outstanding	Postlockup	0.034	0.022	0.037	0.076	0.112
	Diff	-0.019[a]	-0.016[a]			
Rebate rate on shorts %	Prelockup	3.929	4.990	2.290	0.110	-0.180
Rebate rate on shorts %	Postlockup	4.538	5.250	1.718	1.640	0.210
	Diff	-0.608[b]	-0.260			

[a]Significant at the 1 percent level.
[b]Significant at the 5 percent level.

from day -10 to -2, -2.0 percent from day -1 to 0, and -3.3 percent from day 1 to day 10. This evidence is consistent with the model, that is, the introduction of sellers to the market causes prices to drop. However, our analysis follows a short event-study window, while our explanation suggests continued selling and longer-term effects.

Table VI, Panel A, documents the difference between excess returns on Internet stocks over six month periods pre- and postlockup expiration, excluding the previously documented days around the lockup end. The idea of this analysis is that the six-month postlockup period is a long enough interval to allow the "pessimistic" investor to sell out of their position, and the comparison to the prelockup period controls for the actual inability to sell. The difference is -0.11 percent on a daily basis (or -13.8 percent on a six-month basis). Put together, the 8.6 percent decline around the lockup period and the 13.8 percent relative decline postlockup suggests over 22 percent reduction in excess returns due to lockup expirations in a period dominated by optimistic investors.

Moreover, the difference increases to − 0.22 percent on a daily basis (or − 26.4 percent on a six-month basis, − 35.0 percent including all days) over the sample period prior to the crash of March 2000. In contrast, postcrash, the − 0.22 percent difference disappears and is actually a positive 0.09 percent, though not statistically significant. At first glance, this result might seem counter to the theory. However, if the crash already caused the distribution of investors to change, or caused the optimistic investors to lose their bubblelike beliefs, then we would not expect any difference. As limited evidence for this explanation, Table VI, Panel B, shows that the correlations of the relevant Internet stocks and the Internet index are higher postcrash than precrash. That is, irrespective of whether their

Table VI

Long Horizon Comparison of Pre- and Postlockup Excess Returns

Panel A compares average daily excess returns between the six-months pre- and six-months postlockup expiration periods for Internet firms. The excess return is the difference between the return on the stock and the Internet index. (These excess returns exclude days − 10 to +10 around the lockup expiration). Panel B compares the correlation between the Internet firms' stock returns and the return on the Internet index, pre- and postcrash. These periods cover 10 months from May 1999 through February 29, 2000 (precrash), and 10 months from March 2000 through December 31, 2000 (postcrash). These firms must have at least 100 trading days during this period to be included in the sample.

Panel A: Differences in Excess Returns of Internet Stocks Pre- and Postlockup End

	Daily excess return	Observations
Full period 1/1998–12/2000		
Postlockup expiration	0.08%	18,877
Prelockup expiration	0.19%	24,489
Difference	− 0.11%[c]	
Precrash 1/1998–2/2000		
Postlockup expiration	0.01%	8,688
Prelockup expiration	0.23%	18,508
Difference	− 0.22%[b]	
Postcrash 3/2000–12/2000		
Postlockup expiration	0.13%	10,189
Prelockup expiration	0.04%	5,981
Difference	0.09%	

Panel B: Correlation Between Stock Returns of Internet Stocks and the Internet Index

Period	Mean	Median	Std	Low	High
Precrash correlations (5/1999–2/2000)	0.3552	0.3684	0.1460	− 0.0368	0.6815
Postcrash correlations (3/2000–12/2000)	0.3988	0.4130	0.1761	− 0.0240	0.7659
Difference in correlations	− 0.0437[a]	− 0.0446[c]			

[a]Significant at the 1 percent level.
[b]Significant at the 5 percent level.
[c]Significant at the 10 percent level.

lockups have expired, stocks tend to move closer together after the Internet price fall. This is consistent with greater homogeneity among investors after the crash (see, e.g., Hong and Stein (2001)).

The interpretation of these long-run results very much depends on the assumption that selling takes place gradually. Otherwise, all the locked-up investors would sell immediately and the 20–30 percent price drop should occur instantaneously. To get at this issue, we collected data on insider sales both pre- and post-lockup from form 4 (using the reported transaction date). Table VII, Panel A, documents month by month the average insider selling for Internet firms relative to the lockup expiration. Three interesting stylized facts emerge. First, there is a

Table VII

Insider Selling

Panel A shows the frequency of number and the dollar of insiders selling per firm relative to lockup expiration. Month 0 starts at the lockup expiration day. The sample includes 305 Internet IPOs between 1/1998 and 4/2000. Panel B shows an event study around 4,000 insider sell days. Day 0 is the reported day of the transaction. Day 0 actual return = close price/average sell price by insiders − 1. The excess return is the difference between the actual return on the stock and the Internet index. Cumulative return is the sum of the daily excess return with the exception of day 0. In column 2, day 0 actual return is used, while in column 4, day 0 excess return is used.

Panel A: Insider Sales for Internet Firms Around Lockup End

	Insider Selling per Firm	
Month Relative to Lockup Expiration	Number of Insiders	Million $
−6	0.467	3.01
−5	0.067	0.01
−4	0.227	0.65
−3	0.677	3.33
−2	0.763	7.10
−1	0.797	4.11
0	3.956	7.64
1	4.536	7.63
2	4.007	4.81
3	3.992	8.00
4	3.480	10.63
5	2.848	7.06
6	3.604	6.19

Panel B: Excess Returns for Internet Stocks Around Insider Sales

	Day 0 actual return		Day 0 excess return	
Period	Cumulative return	*t*-stat	Cumulative return	*t*-stat
Day 0	−0.10%	−1.34	−0.31%	−4.08
Days 0 to 1	−0.35%	−2.92	−0.57%	−4.58
Days 0 to 2	−0.44%	−2.81	−0.65%	−4.13
Days 0 to 3	−0.52%	−2.23	−0.73%	−3.14

significant jump in insider sales on the lockup expiration and thereafter. For example, in the six-month prelockup period, the number of insiders, on average, is never more than one-fourth postlockup, and (one month aside) the dollar amounts are usually at most one-half. Second, and most important, there is continued selling throughout the postlockup period. In fact, there is no evidence that, upon lockup expiration, there is much greater insider selling, either in numbers of insiders or dollar amounts. For example, at expiration, the mean number of insiders is 3.96 with $7.64 million in sales, compared to, say three months later, 3.99 insiders with $8.00 million in sales. In fact, the sales, measured by both insiders and dollar amounts, around the lockup expiration lie in the median range of the following six months.

Third, as the lockup end approaches, there is an increase in the number of insiders selling, presumably through either (a) a secondary offering or (b) permission granted from the underwriter. For example, four months prior to the lockup end, 0.22 insiders sell on average $0.65 million versus, just the month prior to the lockup, 0.80 insiders selling $4.11 million. This result may explain the phenomena that prices drift down prelockup expiration. Previous researchers, including ourselves, have initially interpreted the downward drift as investors selling on anticipation of the lockup end. This makes little sense from a market rationality perspective (i.e., if sell today, why not yesterday?). Here, one can view the price drop simply as a shift in the investor clientele as more pessimistic investor's beliefs get impounded in prices.

Another way of understanding this latter view is to analyze what happens to the stock price upon an insider sale. Since these sales do not have to get reported until the following month, the information is not public. However, the sale itself should incorporate the beliefs of the insider, that is, diversification aside, they will sell at prices only above their beliefs. Again, this assumes that beliefs are not yet fully aggregated due to short sales restrictions. Therefore, we calculate an event study with the insider sale as the event. Though the time of the transaction is not known, the price the insider sold at is reported. Therefore, we measure the return on the stock from the insider transaction price to the close of trade that day.[12] We also report an excess return. Due to the unknown time of the transaction during the day, however, this excess return is calculated by taking the stock's return since the insider trade, and then subtracting out the index return albeit over the whole day.

Table VII, Panel B, reports the results. Consistent with the story, the excess returns around the sale are negative and statistically significant. For example, the average raw return and excess returns are -0.10 percent and -0.31 percent, respectively. This result assumes that the seller's beliefs get incorporated somewhat immediately. Because we do not know the transaction time, we also carry the return through to following days. All following days are in excess terms and are therefore adjusted for the Internet index. The evidence gives further support

[12] There are a number of days in which there are multiple insider sales. On these days, the average price across the insider sales is used.

to the theory; for example, including the next day's return, the raw and excess returns are -0.35 percent and -0.57 percent, respectively.

Thus, the fact that insider sales continue throughout the lockup period, and that these sales are associated with negative returns, goes a long way to explain the postlockup drift in excess returns on Internet stocks. Specifically, note that there are approximately 4,000 insider sales transactions on different days, which means approximately 13 to 14 transactions on average per firm. Thus, over seven percent decline in *excess* returns in the postlockup period can be attributed to these sales. Moreover, these results ignore the sales of other locked-up investors, such as venture capitalists and angel investors.

IV. The Bubble Bursts: Macro Effects of the Lockup Period

The results in Section III.B imply that the end of the lockup period has a significant effect on Internet stock prices. For example, precrash, we find a 34 percent fall in the stock price, *relative* to the Internet index, at the lockup end. That is, on a stock-by-stock basis, because previously short selling restricted pessimistic investors who can now sell their shares, individual share prices reflect a wider dispersion of beliefs. Does this empirical fact suggest a possible explanation for the Internet bubble burst?

We think it does. Suppose part of the Internet bubble's support derives from the combination of overly optimistic investors and momentum traders who are trying to capitalize on the belief that prices will continue to rise. Towards the latter part of 1999 and particularly in spring 2000, there were a large number of investors —insiders, venture capitalists, institutions, and sophisticated investors—who were free to sell their Internet shares (through the unwinding of their lockup agreements). To the extent that these investors did not have the same optimism about payoffs that existing investors had, their beliefs would now get incorporated into stock prices. As the amount of potential selling increased, this new class of investors (whether they were pessimistic or agnostic) began to overwhelm the optimistic ones.

Figure 2 graphs both the dollar amount of shares being unlocked by month and the cumulative effect over the sample period January 1998 to September 2000.[13] The results are quite striking. By the summer of 2000, almost \$300 billion of shares had been unlocked in a short period of time. To provide more direct evidence of selling (of new) shares we look at aggregate insider selling. Figure 3 shows that a considerable number of unlocked shares were indeed sold by documenting the number of insider transactions per month. In particular, there is a steep rise in the number of insider transactions from January 2000 through September 2000 compared to the previous two years. Also, as reported in Table VII, Panel A, after the expiration of the lockup, insider selling continues at a very high pace for at least six months after lockup expiration. These insider transactions most probably underestimate the amount of selling due to the lockup end, as they

[13] The cumulative effect is simply the addition of the dollar value of the shares at lockup expiration; thus, the cumulative effect does not make any adjustments for the change in value of the shares after the lockup expiration.

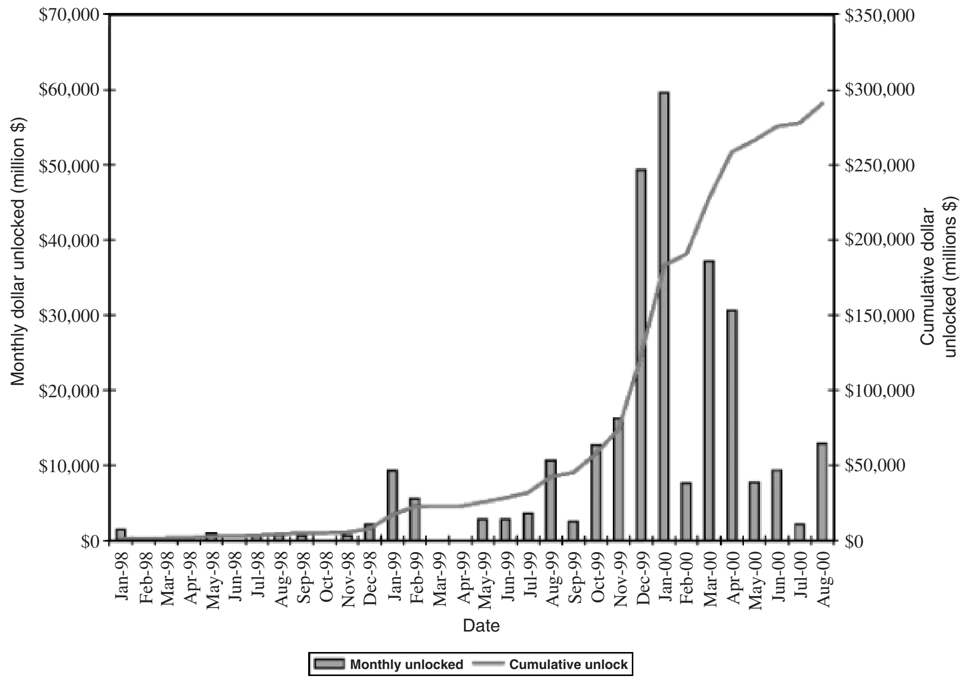

Figure 2. Total dollar value of shares that were released from lockup. Monthly dollar value and cumulative dollar value of shares that were released from lockup that month. The sample includes 327 Internet firms between January 1998 and August 2000. The monthly dollar value per firm is calculated as the total number of shares released from lockup in a given month times the stock price at end of the month. The cumulative dollar value for a given month is the sum of monthly dollar values starting January 1998 and ending that month.

typically do not include venture capitalists (VCs) and angel investors. As noted by Brav and Gompers (2002), VCs tend to pass the shares to their investors once they are free to trade and thus avoid reporting. It is likely that those investors will sell the stock shortly after receiving it.

As these shares become unlocked, and eventually are sold, there must be sufficient capital on the other side to support the Internet price levels. Because these levels are not justified via their cash flow fundamentals, this new capital must come from a new source of optimistic investors. In addition, this problem is actually magnified as the firms themselves were issuing (i.e., selling) additional shares. Figure 4 documents some portion of the total dollar value of new Internet shares sold, including insider selling, IPO proceeds, and seasoned equity offerings. Figure 4 shows that these cumulative sales reach their peak in terms of their gradient in March through April 2000. Thus, to the extent that the magnitude of the volume in new sales pushes the marginal investor away from the optimistic clientele, prices should drop as this huge amount of capital works its way through the market. These price drops have the amplifying effect of driving momentum investors away as well.

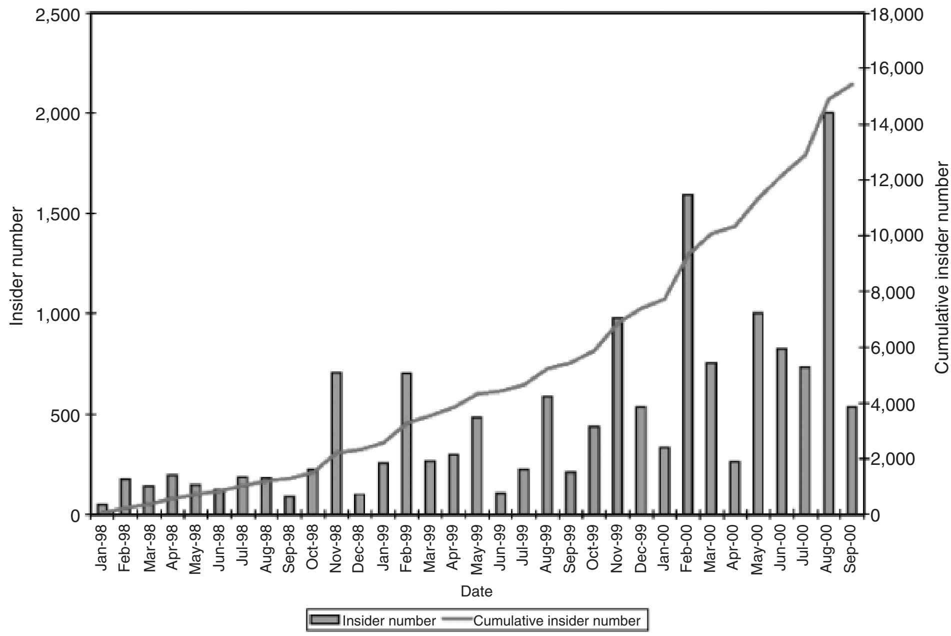

Figure 3. Number of insider selling transactions per month. Monthly number of reported insider-sell transactions in a given calendar month and cumulative number of the transactions from January 1998 to that month. The sample includes 327 Internet firms between January 1998 and September 2000.

A comparison of Figure 1, the Internet stock price history, and Figures 2 through 4 is illuminating. From November 1, 1999, to April 30, 2000, the amount of unlocked shares, insider sales, and new issues increased dramatically. What happened to the level of Internet stock prices over this same period? As Figure 1 shows, from November 30, 1998, to November 30, 1999, the Internet index rose from 200 to 830. If this rise was due to optimism about the future payoffs of the stocks, and, in particular, due to a belief about future prices (absent fundamentals), the rise is consistent with the self-fulfilling properties of a bubble. While the index still rose over the next several months, it did so at a much slower rate. Perhaps the slowdown in the rise of Internet prices may have been due to the beginnings of less optimistic investors selling their unlocked shares. As prices stopped rising, optimistic investors' bubblelike beliefs about future prices were also affected, leading to a twofold effect on Internet prices.[14] The fall of the index

[14] This paper has not taken a view on whether the "optimistic" beliefs are driven by irrational beliefs about cash-flow fundamentals versus some appeal to the theory of rational bubbles, such as the "greater fools" theory (e.g., Blanchard and Watson (1982), Froot and Obstfeld (1991), and Sheinkman and Xiong (2002)). In either case, a precipitous drop in stock prices due to lockup expirations would presumably affect the beliefs structure.

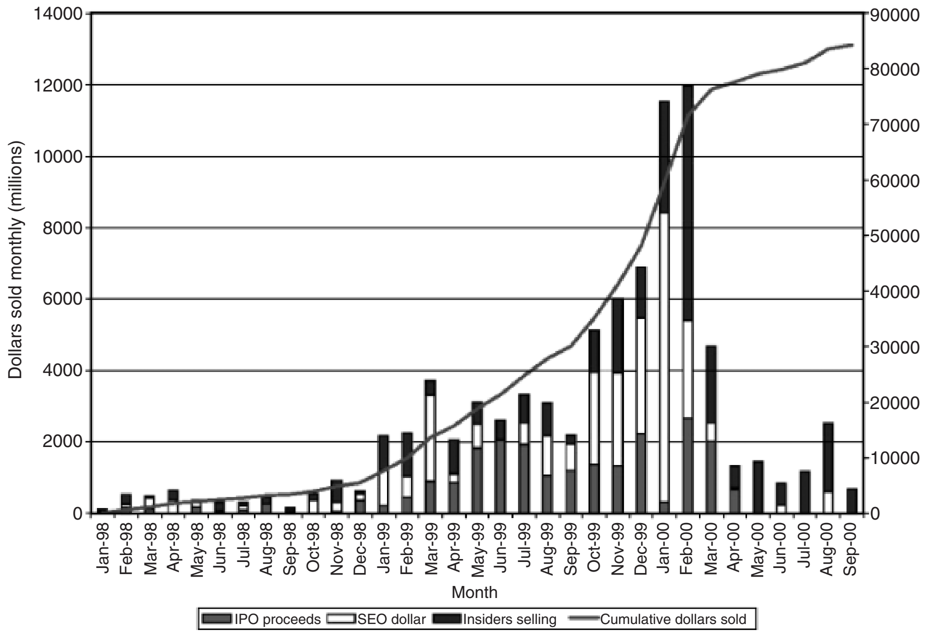

Figure 4. Dollar value of new Internet shares sold to the public. Monthly dollar value and cumulative dollar value of shares in Internet firms that were sold to the public for the first time either in and IPO or SEO or by insiders. The sample includes 327 Internet firms between January 1998 and September 2000. The cumulative dollar value for a given month is the sum of monthly sells from all sources starting in January 1998 and ending that month.

from 1,030 to 430 from March 1 to April 30, 2000, coincides with the simultaneous increase in unlocked shares. Once the bubble had burst, there was no longer support, as optimistic investors' beliefs had been permanently altered.

V. Concluding Remarks

If a set of investors enters the market, or all of a sudden becomes very optimistic, then stock prices can rise quite dramatically. Pessimistic investors would like to short these "overvalued" stocks but are prevented from doing so. That is, pessimistic traders were trying to bring markets back to reasonable price levels, but they were being overrun by the size and volume of optimistic trading. While this story may help explain *any* type of inflated stock price level in the context of limited arbitrage, it seems especially suited to stocks that are especially subject to short sales constraints and heterogeneous investors.

This paper investigates this theory by looking at the behavior of Internet stock prices during the extraordinary asset pricing period from January 1998 to February 2000. We provide three important findings. First, using evidence on short sales, rebate rates, and option pairs, we document substantial short sales restrictions for Internet stocks. Second, using data on Internet holdings and block trades (around IPO-related events with shifting investor clienteles), we show a link between heterogeneity and price effects for Internet stocks. Third, as an application, we provide a detailed look at the impact lockup expirations had on Internet stock prices. Because lockup expirations are equivalent to loosening the short sales constraint, we document average, long-run excess returns as low as -34 percent for Internet stocks postlockup. Moreover, the long-run impact of the lockup expiration is related to gradual insider selling throughout the period.

Of some interest, the above story and supporting evidence provide a unified view of the rise, persistence, and eventual fall of Internet stock prices. There are several interesting directions for future research. First, one of the potent things about the evidence on Internet stocks is the mere magnitude of the effects. There are many examples, both within the United States (such as the crash of 1929) and outside the United States of amazing rises and falls in asset prices. Can the theory and evidence of this paper be helpful in analyzing these additional cases? Moreover, can the combination of limited arbitrage (i.e., short sales constraints) and heterogenous investors explain financial anomalies in general? Second, our paper has ignored the relative volatility differences between Internet and non-Internet stocks. Results in Table I, for example, show that Internet stocks were 5.9 times more variable, yet had 37.5 percent lower spreads than non-Internet stocks. The magnitude of this volatility needs to be integrated into a full explanation of the Internet rise and fall. Third, rational investors had access to derivatives during this period, for example, index futures and equity options, and could have used these financial assets to bet against Internet movements, thus, relaxing the short sales constraint. A full analysis of whether this occurred, and, if not, why not, seems relevant for a complete understanding of the way capital markets behaved during the 1998 to 2000 period. In any event, this paper provides a first step at generating a complete, cohesive explanation of the Internet bubble.

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