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The Dotcom Bubble and Underpricing: Conjectures and Evidence

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We provide conjectures for what caused the price spiral and the high underpricing of the dotcom bubble of 1999–2000. We raise two conjectures for the price spiral. First, given the uncertainty about the growth opportunities generated by the new technologies and their spillover effects across technology industries, investors saw the inflow of a large number of high-growth firms as a sign of high growth rates for the market as a whole. Second, investors interpreted the wave of highly underpriced IPOs as an opportunity to obtain gains by investing in newly public companies. The underpricing resulted from the emergence a large cohort of firms racing for market leadership. Fundamentals pricing at the IPO was part of their strategy. We provide evidence for our conjectures. We show that returns on NASDAQ composite index are explained by the flow of high-growth (or highly underpriced) IPOs; the high underpricing can be fully explained by firms' characteristics and strategic goals. We also show that, contrary to alternatives explanations, underpricing was not associated with top underwriting, there was no deterioration of issuers' quality, and top underwriters and analysts became more selective.

Keywords: Internet bubble, underpricing, spinning, analyst lust, risk composition hypothesis.

JEL codes: G14, G24, L1, O33.

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1 – Introduction

The Dotcom bubble and the concomitant high underpricing are two puzzles. From 2,000 points in the beginning of 1999, the NASDAQ composite index escalated to 5,048 in March 2000, returning to near the 2,000 points after 2000. The average underpricing escalated from 14.3 percent in the 1991-1998 period to 64.9 percent in 1999-2000 (Ritter, 2014). This article presents a rational explanation connecting these two phenomena. We conjecture that the large inflow of IPOs of fast growing firms affected the expectation about the long-term growth rate of New Economy firms and consequently, their evaluation, feeding the price spiral. The high underpricing originated from the strategic behavior of some issuers for which the continued use of capital market was a need: the possible overvaluation of their shares forced them to highly underprice their IPOs.

The birth of the Internet spurred a variety of new products and processes (the so-called New Economy). The Internet also changed the structure of many traditional businesses. For example, it allowed for improved inventory management and new manners of marketing products, stimulating market consolidation in some traditional industries. It even allowed some local businesses to become global (e.g., Amazon.com). The use of new processes even raised doubt on whether these new businesses would subsume traditional ones. Such business revolution fostered a large cohort of new firms in a race for leadership (or survivorship). These firms needed to go public either to raise cash to fund organic growth, or to turn their shares into currency to pay for acquisitions.[1] Thus, for them the continued use of the capital markets was important. New Economy firms also presented abnormal realized growth rate, but their track record was short because they were young. Short track record along with uncertainty about the effectiveness the new processes made difficult the assessment of long-term growth rates (Schwert 2002; Schultz and Zaman, 2001).

We conjecture that information on long-long term growth rate coming from the IPO market fed the price spiral. The stock of public New Economy firms was small and the flow of

[1] Brau and Fawcett (2006) examining IPOs from 2000-2001 find that the desire to create an acquisition currency ranks as the most important reason for an IPO. Over a longer sample period, Celikyurt, Sevilir, and Shivdasani (2010) report that newly public firms make acquisitions at a torrid pace.

IPOs was large. Thus, the IPO market became relevant to assess the long-term growth rate of the whole industry. The continued flow of highly underpriced high-growth firms lead investors to update upwards their estimation of the long-term growth rate, causing upward price revision for the whole industry. Therefore, the increase in price was a rational.

Our explanation for the abnormal underpricing builds on the behavior of firms with the need for continued use of capital markets. Such firms, facing the frenzy for their shares, had reasons to be conservative in the pricing of their IPO. First, the continued use of the stock market requires good shares performance (e.g., good price returns, regular analysts' coverage and low bid-ask spreads). Overvalued shares could lose their attractiveness if a market reversion occurred. Second, race for leadership required large pre-IPO capital infusion, lowering CEO's ownership.[2] Maintenance of control with small ownership requires good shares dilution,[3] preferentially among buy-and-hold investors (e.g., small number of shares floating makes difficult for threatening investors to acquire significant ownership). However, underwriters would hardly place potentially overpriced shares among their premier buy-and-hold investors. Third, for an issuer intending to do a series of acquisitions, ownership dilution could come mostly from expensive acquisitions, rather than from IPO underpricing. By selling overvalued shares at their IPOs, strategic acquirers could create unrealistic expectations for acquisition multiples, making acquisitions expensive. Last, venture capital (VC) sponsored firms could want to protect VCs ability to tackle underwriters, auditors, analyst and investors (Barry et al., 1990; Megginson and Weiss, 1991).

We present evidence supporting our conjectures. First, we show that during the bubble the flow of IPOs of fast growing firms explains returns on the NASDAQ composite index. Next, we show that the abnormally high underpricing can be fully accounted by issuers' strategic purposes.

[2] Ljungqvist and Wilhelm (2003) report that average CEO ownership dropped from 23 percent during 1996-1998 dropped to 17.3 percent in 1999 and to 11.6 percent in 2000.
[3] Brennan and Franks (1997) find that when shares are placed more widely rather than placed with just a few powerful large shareholders, the entrepreneur is less easy ousted from the company.

For robustness purposes, we also investigated other conjectures on the origin of the bubble's underpricing. Following Loughran and Ritter (2004), there are three alternative conjectures: 1) C*hange in Risk Composition* (Helwege and Liang, 2004; Howe and Zhang, 2005; Ibbotson, Sindelar, and Ritter, 1994; Loughran and Ritter, 2004; Lowry and Schwert, 2002; Ritter 1984; and Yung, Colak, and Wang, 2008): changing in average underpricing over time reflects change in the riskiness of the IPOs. The main evidence supporting this hypothesis for the Dotcom period is the increased failure rate in three and five years from the IPO (Yung, Colak, and Wang, 2008). However, we show that this increased failure rate prevailed only for a period inferior to 11 years. Furthermore, high-quality firms where the ones that bore the highest underpricing; 2) *Change in Issuer Objective Function*: based on what Loughran and Ritter (2004) call *Analyst Lust*. As issuers placed more importance on hiring lead underwriters that would bring highly ranked analyst coverage, they became less concerned with avoiding underwriters with the reputation for excessive underpricing. Analyst Lust is inconsistent with our findings that analysts' coverage during the bubble is unrelated to underpricing or top underwriting, and that underpricing during the bubble is fully accounted by issuers' strategic goals. Moreover, once one accounts for firms' characteristics, analysts' coverage actually decreased; and 3) *Realignment of Incentives*: increased underpricing resulted from lower incentives for firms' insiders to monitor underwriters. Ljungqvist and Wilhelm (2003) interpret the observed sharp drop in average CEO ownership as a reduction in incentives for CEOs to monitor underwriters. Loughran and Ritter (2004) based their explanation on *spinning*: underwriters that usually force high underpricing co-opted firms' insiders by allocating to them stocks in highly underpriced IPOs. These two conjectures are not consistent with the fact that abnormal underpricing is fully explained by firms' strategic behavior rather than top underwriting.

This article is structured as follows: Section 2 presents our hypotheses and methodology; Section 3 describes our data, sample and variables; Section 4 presents our results; and Section 5 concludes.

2 – Hypotheses and methodology

2.1 – Hypotheses

We conjecture that the large inflow of high-growth IPOs influenced the expectation about the growth rate of whole New Economy feeding the price spiral. We motivate this conjecture with the following simple model:

Suppose that a technology could induce high growth, g_H, or low growth rates, g_L ($g_H > g_L$). Investors a priori do not know the technology growth rate. The *ex-ante* probability of high-growth is given by $\gamma \in (0,1)$. As in Benveniste and Spindt (1989) we assume that during the book-building, institutional investors provide information about the firm that becomes public and common knowledge after the IPO. In particular, we assume that the information gathering process generates a signal about the quality of the technology. Signals can be good (G) or bad (B). If the growth rate is g_H, the probability of a good signal is θ_H. If the technology is low growth, the probability of a good signal is θ_L ($\theta_H > \theta_L$). After every IPO, the growth rate for all the firms using the same technology is updated using Bayes' rule:

$$Prob(g_H|G) = \frac{\gamma\theta_H}{\gamma\theta_H + (1-\gamma)\theta_L}$$

To keep argument simple, let us assume that stocks are valued using the Gordon's Constant Growth Model. Let k be the cost of capital and assume that agents are risk-neutral. Then, after each successful IPO, the expected value of the share is given by:

$$\frac{\gamma\theta_H}{\gamma\theta_H + (1-\gamma)\theta_L} \times \frac{D_0(1+g_H)}{k-g_H} + \frac{(1-\gamma)\theta_L}{\gamma\theta_H + (1-\gamma)\theta_L} \times \frac{D_0(1+g_L)}{k-g_L}.$$

Before the signal was issued, the expected share value was given by:

$$\gamma \times \frac{D_0(1+g_H)}{k-g_H} + (1-\gamma) \times \frac{D_0(1+g_L)}{k-g_L}.$$

Consequently, the expected change in price after a good signal is revealed is given by:

$$\frac{\gamma(1-\gamma)(\theta_H-\theta_L)}{\gamma\theta_H + (1-\gamma)\theta_L} \times \frac{(1+k)(g_H-g_L)D_0}{(k-g_H)(k-g_L)} > 0,$$

where the first term indicates the shift in probability from low to high growth and the second term indicates the net gain in valuation by moving towards a high-growth stock. If the signals are not perfectly correlated, the market valuation of all firms using that technology increases with the number of positive signals. Moreover, the higher the difference between g_H and g_L the bigger the appreciation following a good signal.

It is natural that IPO of firms with historical high sales growth are the candidates to generate good signals about the new technology. The good signal coming from the IPO market is that investors estimate that the historical sales growth is projected for the future. The high underpricing indicating that the growth rate that investors estimate is higher than the initially projected in the IPO valuation, captures the magnitude of the good news. Thus if high sales growth IPO are associated to high underpricing we can state the following hypothesis:

Hypothesis 1: *During the Dotcom bubble, returns on NASDAQ composite index responded to the flow of high growth IPOs.*

With respect to underpricing, we conjecture that the possibility of overvaluation led firms that needed the continued use of capital markets (and thus, could not risk distributing overvalued shares) to highly underprice their IPOs. Thus, underpricing was a consequence of their strategic goals:

Hypothesis 2: *The high underpricing prevailing during the bubble can be fully accounted by issuers' strategy*.

2.2 – Methodology

2.2.1 – Variables

Table 1 described our variables. Most of them are standard in the IPO literature. We discuss here only three variables that proxy for the issuers' strategic goals. These variables are: *Acquisition pre-IPO*, which is a dummy variable indicating that the issuer made acquisitions in the 3-year period before the IPO. The creation of shares for acquisition plays an important role in our conjecture. Ideally, one would want to use acquisitions post-IPO (a dummy variable indicating acquisition within 5 years from the IPO), but such variable would be endogenous to

the analysis of underpricing. Alternatively, we use *Acquisition pre-IPO*. The correlation between these two variables is high: 0.79. Furthermore, only pre-IPO acquirers made acquisitions after their IPOs and only 28 percent of the pre-IPO acquirers did not make a post-IPO acquisition; *Big-Four auditing*, which is a dummy that indicates if the external auditor is one of the top auditing firms. Notice that although the choice of auditing is a strategic decision, it is exogenous to the underpricing analysis since auditors do take part in the going public process; and *Venture capital*, a dummy variable indicating venture capital sponsorship: the strategic role of venture capital in IPOs and its concern with reputation has already been extensively discussed (Barry et al. 1990; and Megginson and Weiss, 1991).

2.2.2 – Econometric models

Hypothesis 1 states that the returns on the NASDAQ composite index responded to the inflow of high-growth IPOs. To measure this correlation one must control for high-frequency macroeconomic shocks. Fortunately, the bubble was mostly restricted to NASDAQ, both in terms of price spiral and IPO flow, barely affecting the New York Stock Exchange index (NYSE). [4] Thus, we use the NYSE index returns to control for high-frequency macroeconomic shocks. Hence, our econometric models to test Hypothesis 1 are:

$$\Delta NASDAQ_t = \beta_1 \Delta NYSE_t + \beta_2 \#IPOs\_Low_t + \beta_3 \#IPOs\_High_t + \varepsilon_t, \quad (1)$$

and

$$\Delta NASDAQ_t = \beta_1 \Delta NYSE_t + \beta_2 \#IPOs_t + \beta_2 proportion(IPOs\_High)_t + \varepsilon_t, \quad (2)$$

where

Δ is the percent change in the market index in period t;

$\#IPOs\_Low_t$ is the number of IPOs with low underpricing in period t;

$\#IPOs\_High_t$ is the number of IPOs with high underpricing in period t; and

$\#IPOs_t$ is the number of IPOs in period t.

[4] During 1999 and 2000 the New York Stock Exchange Composite index (NYSE) varied between 6,092 and 7,164 (only 17.5% variation) and few IPOs in the period occurred at NYSE: 94.6% of our IPO sample during the bubble was at NASDAQ (in Loughran and Ritter, 2004, sample it was 88.6%).

We estimate Equations 1 and 2 using both weekly and three-week rolling returns. In the latter case, we use index returns over three weeks and the number (or proportion) of highly underpriced IPOs over the same three weeks as a moving sum of returns and IPOs. Estimations come from least squares regressions with Newey-West (12 lags) standard errors (Newey and West, 1987).

Robustness: One may be concerned with reverse causality in Models 1 and 2. Accordingly, high market returns could force high underpricing, increasing the number of highly underpriced IPOs. We address this concern in two ways. First, we replace the number and proportion of highly (lowly) underpriced IPOs by the number and proportion of IPOs of high (low) sales growth issuers. Sales growth is highly correlated to underpricing (Table 5), completely predetermined, and hardly correlated to market returns at the time of the IPO. Second, we estimate predicted underpricing and use it to classify IPOs into either highly or lowly underpriced. To predict underpricing we run a least square regression with robust errors on an estimation window and use the estimated parameters to project underpricing over the entire sample period. The econometric model is:

$$Underpricing_i = \gamma_0 + \gamma_1 Issue_i + \gamma_2 Industry\ dummies_i + \mu_i, \quad (3)$$

where

$Issue_i$ is a vector of issue i's characteristics, including: dummy variables indicating VC-sponsorship and Big-four auditing, sales growth, technology, age, firm size, offer size, offer-to-firm size, and the size of the price interval scaled by its middle point.

One should note that, in order to avoid any by-construction correlation with market returns, our model does not include variables that could be related to the timing of the IPO (*ex-ante* demand, top underwriting dummy and quarter dummies). We use two estimation windows: the whole sample period (1991-2000) [5] and the pre-bubble period (1991-1996). Based on predicted underpricing, we classify firms as highly underpriced using several cut-offs (when one

[5] The exclusion of all variables that could be related to the timing of the IPO minimizes the risk of endogeneity when the estimation window includes the bubble period.

uses the pre-bubble period as estimation window, predicted underpricing during the bubble is unsurprisingly low).

Hypothesis 2 states that the high underpricing prevailing during the bubble can be fully accounted by the characteristics and strategic goals of issuers. To test this hypothesis, we run underpricing regressions controlling for the issues' characteristics, issuers' strategic characteristics, and underwriting. Our econometric model is:

$$Underpricing_i = \gamma_0 + \gamma_1 Bubble + \gamma_2 Issue_i + \gamma_3 Strategic_i + \gamma_4 Underwriting_i + \gamma_5 Industry_i + \gamma_6 Bubble \times Strategic_i + \gamma_7 Bubble \times Underwriting_i + \mu_i, \quad (4)$$

where

$Issue_i$ is a vector of characteristics of issue i: technology, age, offer size, firm size, offer-to-firm size, sales growth and the size of the price interval scaled by its middle point;

$Strategic_i$ is a set of three dummy variables indicating pre-IPO acquisitions, Big-four auditing (Big_four) and VC-sponsorship; and

$Underwriting_i$ is a dummy variable indicating that the Carter-Manaster reputation index is above 8.

In our basic setting, we do not control for the *ex-ante* demand for the IPO (*price revision up* and *price revision down*) because it can be related to the underwriter's selling effort and to the IPO timing. Nevertheless, we also present estimations controlling for *ex-ante* demand for robustness purposes.

If Hypothesis 2 is correct, interactions of the bubble dummy with our proxies for strategic goals (Acquisitions pre-IPO, Big-four and Venture Capital) fully explain the abnormal underpricing observed during the bubble; i.e., the coefficients on the bubble dummy and its interaction with top underwriting will not be statistically significant.

We then move to discuss our robustness checks by considering the alternative scenarios proposed by the literature. In order to investigate the change in risk composition we use means comparison of the average quality of the bubble and pre-bubble IPO cohorts. Our quality

measure is the frequency of failures. Our indirect measures are: institutional ownership[6] and its concentration, certification by reputable underwriters and auditors, and enhanced tradability conditions (analysts' coverage and bid-ask spreads). We measure tradability conditions and institutional ownership at the end of the second year from the IPO. This allows for the effect of underwriter efforts at the IPO to wear out.

There are two objections to the use of top underwriting and analysts' coverage as quality measures during the bubble, which are related to our other robustness tests. First, Loughran and Ritter (2004) suggest that top underwriters increased market share by lowering their standards (we call this *Underwriters' Opportunistic Behavior*). If so, top underwriting would not signal quality. Second, the same authors conjecture that during the bubble, firms coped with underwriters with a reputation for severe underprice in exchange for analyst coverage (*Analyst Lust*). Therefore analysts' coverage was related to underpricing and underwriting rather than issuer quality. We test these two conjectures using probit analysis on the choices of underwriters and analyst coverage. Our specification for these tests is:

$$Dependent_i = \beta_0 + \beta_1 Bubble + \beta_2 Issue_i + \beta_3 Industry_i + \mu_i, \quad (5)$$

where

$Dependent_i$ is either a dummy variable indicating Carter-Manaster index for underwriters' reputation above 8, or a dummy variable indicating analysts' coverage during the second year from the IPO;

$Bubble$ is a dummy variable indicating the bubble years (1999-2000);

$Issue_i$ is a vector of predetermined characteristics of issue i: VC-sponsorship, Big-four auditing, high-growth, pre-IPO acquisition, age, technology, firm size, offer size, offer-to-firm size and sales growth (in the analysis for analysts' coverage we also include underpricing, the top-underwriting dummy and their interactions with the bubble dummy); and

$Industry_i$ is a set of 9 industry dummies.

If the *Underwriters' Opportunistic Behavior* is right, one would observe a positive coefficient on the bubble dummy in the probit analysis for top underwriting. If the *Analyst Lust*

[6] One would expect institutional investors to run away from bad quality firms, decreasing institutional ownership and increasing the Herfindahl index.

is right, one would observe positive coefficients on the interactions of bubble dummy with underpricing and top-underwriting

3 – Data and sample

Our dataset combines data from several sources. From Securities Data Corporation (SDC-Platinum) we obtained an exhaustive list of IPOs and information on offer price, offer date, proceeds, leading underwriter, price interval, issuer age and seasoned equity offerings (SEO). We complemented and corrected SDC-Platinum database following suggestions in Jay Ritter's website (Ritter, 2014). From Compustat we obtained data on quarterly and annual fundamentals: sales, book value of assets, and Big-Four auditing. Information on VC-sponsoring comes from Venture Economics database. Analysts' coverage comes from the I/B/E/S database. Data on institutional ownership and its Herfindahl index comes from Thomson Reuters Institutional Holdings (13F). As measure of underwriter quality we use the Carter and Manaster index (1990) updated by Loughran and Ritter (2004). Information on bid-ask spreads, delisting due to bankruptcy, mergers and drops, and daily quotation for NYSE and NASDAQ composite indices come from the CRSP-US. We use Loughran and Ritter's (2004) classification to identify High-tech firms. We define three periods: *Pre-bubble* (1991-1996), *Transition* (1997 and 1998) and *Bubble* (1999 and 2000).

Our sample consists of firms completing an IPO between January 1991 and December 2000. As usual, we exclude offerings from closed-end funds, limited partnerships, financial institutions (SIC codes 6000–6999), utilities (SIC codes 4900–4999), real-estate investment trusts, unit offerings, IPOs with offer price below five dollars, and American depositary receipts (ADRs). Our final sample consists of 2,754 IPOs with complete information on all variables used in underpricing regressions. Table 2 describes the drop in sample size due to missing values in relevant variables.

Table 3 compares our sample to that of Ritter (2014). During the pre-bubble and transition periods our coverage is 58 and 61 percent of his sample. During the bubble period, the coverage is higher: 70 percent. Overall, our sample comprises 62 percent of his sample. Samples are similar in terms of underpricing, proportion of IPOs at NASDAQ, VC-sponsorship, median

age, and proportion of IPOs with price revision up (down) in an annual basis. Differences are large for gross proceeds in 2000 and technology during the pre-bubble and bubble periods. During the pre-bubble period our sample has a higher proportion of technology firms, but during the transition and bubble periods, that proportion is significantly lower.

3.1 – Change in IPO characteristics

Table 4 (Panel A) reports issuers' characteristics in three distinct periods pre-bubble (1991-1996) transition (1997 and 1998) and bubble (1999-2000). It also compares pre-bubble to bubble periods. Panel A describes the entire sample while Panel B only the subsample of high-growth firms. The sales growth cutoff used to classify firms into high-growth was the cutoff for the highest quartile of the pre-bubble subsample. Keep in mind that the pre-IPO sales growth – measured by the average quarterly growth - increased significantly during the bubble, from 56% to 91%. Consequently, firms at the top-quartile during the bubble presented significantly higher sales growth than their counterparts outside the bubble.

The general message of Table 4 is that IPO characteristics changed from the pre-bubble to the bubble periods due to not only an increase in the proportion of high-growth issuers (from 13 to 41%) but also a change in the characteristics high-growth IPOs. From the pre-bubble to the bubble period, firm age declined from 14.6 to 9.4 years. In the high growth subsample such decline was from 9.03 to 6.07 years. Thus high growth firms during the bubble were very young; the fraction of IPO from technology firms increased from 29 to 50 percent, similar change was occurred among high growth firms: from 32 to 54 percent; firm size (measured by book value of assets) increased from $164 to $255 mi. Among high growth firms size almost tree folded: from $95 to $246 mi; offer size increased from $58.8 million to $116.1 million. Among high growth firms offer size increased from $53 million to $112 million; in terms of the presence of VC backing and a top underwriter at the IPO, there was an increase during the bubble period from 41 to 67 percent and from 68 to 84 percent, respectively. In the high growth subsample, the increase was from 57 to 77 percent and from 75 to 86 percent, respectively; underprice increased from 16 to 66 percent. The increase was more pronounced for high-growth firms: from 24 to 82 percent; there was no sizable change in Big-four auditing: an increase of 3 to 4 percent in both samples;

and a decrease on pre-IPO acquisitions from 33 to 25 percent in the whole sample and from 31 to 26 percent among high-growth firms.

4 – Results

4.1 – Price spiral

Table 5 presents estimations for Models 1 and 2 that test for a positive relation between the number (or proportion) of IPOs of high-growth firms and the variation of the return on NASDAQ composite index (Hypothesis 1). Regressions 1-6 analyses the bubble period. Regressions 1-3 report analysis on rolling three-week returns while regressions 4-6 report results on weekly returns. Regression 1 includes only the variation on the NYSE composite index (ΔNYSE) and the total number of IPOs (#IPOs) in the period. As expected, the coefficient on ΔNYSE composite index is positive, near to one (0.948), although its statistical significance is only marginal (t-statistics is 1.77). The coefficient on #IPOs is virtually zero in magnitude and statistical significance. R-square coefficient is only 0.09. In Regression 2 we include also the mean sales growth of the IPOs during the equivalent period. Now both the coefficients on the numbers of IPOs and mean sales growth are marginally statistically significant. The coefficient for the number of IPOs is negative (-0.007, t-statistics is -1.95), while the coefficient for the mean sales growth is positive (0.001, t-statistics is 1.86). The coefficient on ΔNYSE loses statistical significance even though does not change much in value (t=1.62). R-square coefficient increases sharply to 0.23, showing a significant increase in the model's predictive power. Regression 3 includes instead of the mean sales growth, the number of IPOS with high sales growth in the period pre-IPO, i.e., the number of IPOs at the top quartile in the sales growth distribution. Results become significantly stronger in terms of statistical significance: the coefficient for the number of IPOs with high sales growth in the pre-IPO period is 0.027 and t-statistics increases to 2.85. The coefficient on the number of IPOs becomes -0.010 with t-statistics of -2.71. Once more, the coefficient on ΔNYSE loses statistical significance (t=1.63). R-square statistics showed a minor change to 0.21.

Regressions 4-6 focus on NASDAQ weekly variations. Results are qualitatively the same. As expected, the coefficient on NYSE becomes larger in size and statistical significance

than in regressions 1-3, indicating that weekly variation on NASDAQ is more responsive to macroeconomic high frequency shocks. Regression 4 shows that the number of IPOs by itself is not statistically significant. In Regression 5 the coefficient on the average sales growth is 0.001 with five percent statistical significance and the coefficient on the number of IPOs is -0.002 and statistically significant at ten percent with t-statistic -1.93. Finally, in Regression 6 the coefficient on the number of high growth IPOs is 0.01 with statistical significance at the one percent level. The coefficient on the number of IPOs is -0.004, significant at the five percent level. From Regression 4 to Regressions 5 and 6 the R-square statistics increases only slightly from 0.19 to 0.22 and 0.23. Regressions 6 allows one estimate the effect of IPOs on NASDAQ returns: the coefficient on the number of IPOs is -0.0039 and in our bubble sample there were 633 IPOs. The coefficient on the number of high-growth IPOs is 0.0103 and there were 261 of such IPOs. Thus over the bubble period the predicted variation on NASDAQ index is 19 percent. Over the same period the actual variation was 20 percent (from 2,192 to 2,626 points)

Regressions 7-9 replicate the results for regressions 1-3 while focusing only on the 1999 sub-sample. As we know, the technology IPO market already started showing some weakness in 2000, so focusing on 1999 is likely to strength our results. As expected, results become stronger but qualitatively the same. In regression 7, the coefficient on NYSE is positive and statistically significant at the one percent level. The coefficient for the number of IPOs is 0.004 and statistically significant at the one percent level. In regression 8, we introduce mean sales growth of the IPOs during the equivalent period. As expected due to the results in regression 2, the coefficient for number of IPOs becomes negative (-0.005) and statistically significant at the five percent level. Finally, the coefficient for mean sales growth is 0.001 with t-statistic 4.00. Regression 9 substitutes the mean sales growth by the number of IPOs with high sales growth, i.e. IPOs with sales growth in the top quartile. As in regression 3 results, in regression 8 the coefficient for the number of IPOs stays negative and statistically significant at the one percent level, while the number of high-growth IPOs is 0.025 with t-statistic 4.16. Regressions 10-12 replicate the specifications presented for regressions 4-6 while focusing on the 1999 subsample. As expected, results are qualitatively similar and quantitatively stronger to the ones obtained in regressions 4-6, corroborating the assumption that the 1999 subsample is a cleaner sample to

study the impact of the signal of long-term growth on the market. Regressions 12 also allows one estimate the effect of IPOs on NASDAQ returns: the coefficient on the number of IPOs is -0.0007 and in our 1999 sample there were 345 IPOs. The coefficient on the number of high-growth IPOs is 0.0076 and there were 51 of such IPOs. Thus, over the bubble period the predicted variation on NASDAQ index is 15 percent. Over the same period the actual variation was much higher: 77 percent (from 2,192 to 3,887 points)

Regressions 13-24 replicate specifications used in regressions 1-12 but using two different samples: The pre-bubble period (1990-1996) and the transition period (1997-1998). As we can observe, throughout all these regressions, the only coefficient that is statistically significant it is the one for the variation on the NYSE composite index, indicating that only macroeconomic variations play a role in the movements of the NASDAQ index. Consequently, our results corroborate Hypothesis 1's statement that during the bubble, NASDAQ index responded to the flow of high-growth IPOs, a fact that it is not present in other adjacent periods.

4.2 – Underpricing in the bubble

Our Hypothesis 2 states that the high underpricing prevailing during the bubble is fully accounted by issuers' characteristics and strategic goals rather than underwriter's behavior. Table 6 investigates underpricing during the bubble (Model 2). Regression 1 includes only the usual controls plus the Bubble dummy.[7] The coefficient on the bubble dummy is 0.358 (35.8 percent) with statistical significance at the one percent level. Thus the increase in underpricing during the bubble is not fully explained by change in firms' characteristics. Notice that the coefficients on the dummies for VC, Big-four, High-growth, Acquisition pre-IPO and Young are positive and statistically significant at the one percent level.

Regression 2 includes the interaction between top-underwriting and the bubble dummies. Now the coefficient on the Bubble dummy drops to 0.249 that is significant at the one percent level. The coefficient on the interaction is 0.137 that is significant at the 10% level, suggesting

[7] We do not include controls for the *ex-ante* demand because they could be correlated to the bubble itself.

that part of the underpricing incurred during the bubble was due to the action of top underwriters. This result is similar to that of Loughran and Ritter (2004).[8]

Regression 3 examines the effect of VC sponsorship and pre-IPO acquisitions during the bubble on underpricing. The interaction of VC and bubble dummies has coefficient of 0.273 that is statistically significant at the one percent level indicating that VC sponsored firms bore additional 27.3 percent underpricing. Similarly, the interaction with the acquisition dummy has coefficient of 0.213 that is statistically significant at the one percent level. The coefficients on the bubble dummy drops to 0.074 and that on its interaction with top underwriting to 0.087. Both coefficients lose statistical significance. Thus, the underpricing during the bubble can be fully accounted by the behavior of VC and pre-IPO acquiring firms. Notice that once we include the interaction of VC and bubble dummies, the coefficient on VC loses statistical significance. Therefore, out of the bubble period VC sponsorship does not affect underpricing. Distinctively, the coefficient on Acquisition pre-IPO remains statistically significant at the 10 percent level, even though its magnitude drops from 0.072 to 0.023.

Regression 4 includes additionally the interaction between the bubble and Big-four dummy. The coefficient on such interaction is 0.217 that is statistically significant at the one percent level. Notice that now the coefficient on the bubble dummy becomes negative but still non-significant. The inclusion of this interaction does not change the magnitudes of the coefficients on the interactions of VC and Acquisition pre-IPO.

It is possible that our three strategic variables also have a selection component. For instance, VC-sponsored firms are frequently young, focused on technology and belong to high-growth industries. In order to disentangle these two components, regression 5 includes interactions between the bubble dummy and the dummies three for firms' characteristics (high-growth, technology and young). All of these interactions bear coefficients near 15 percent that are statistically significant at the five or 10 percent levels. Now the coefficient on the interaction of the bubble and VC dummies drops from 0.27 (Regressions 3 and 4) to 0.18, but remains

[8] We note that these authors did not include in their analysis any other interaction with the bubble dummy.

statistically significant at the one percent level. This means that from the 27 percent extra underpricing bore by VC-sponsored firms, only 9 percent was due to their characteristics. The magnitude of the coefficient on the interactions between the Acquisition pre-IPO, Big-four and bubble dummies are only marginally affected by firms' characteristics, suggesting that the Acquisition pre-IPO and Big-four variables capture only strategic behavior.

Regression 6 drops the bubble dummy to include its interaction with the Non-top underwriting dummy. The coefficient on the interaction with the top-underwriting dummy becomes negative (-0.077) but still fails to present statistical significance (t-statistics is -1.13). Regression 7, for robustness purposes, includes controls for the *ex-ante* demand (price revision up and price revision down). The coefficient on the bubble dummy becomes -0.173 that is statistically significant at the 10 percent level. The coefficient on the interaction of the bubble and top-underwriting dummies remain positive but without statistical significance (t-statistics is 1.10).

Overall, our underpricing analysis indicates that the abnormal underpricing observed during the bubble was due mostly to firms' characteristics and their strategic behavior, corroborating Hypothesis 2. We find no evidence that such abnormal underpricing was driven by top-underwriters' actions.

4.2.1 – Robustness checks

4.2.1.1 – Risk Composition Hypothesis

We will now discuss some robustness tests that consider alternative theories for the market's bubble behavior. We start with the *Risk Composition hypothesis* (*RCH*) that assumes that issuers' quality decreased during the bubble period. We now investigate changes in issuers' quality.

One of the main evidences supporting *RCH* is the increased rate of failure (delisting due to bankruptcy or drop reasons) within the first five years from the IPO (Yung, Colak and Wang; 2008). We look at the evolution of failure rates along the years from the IPO (Table 7).

Compared to the pre-bubble period, failure rate within three years from the IPO during the bubble is almost three times bigger: 14.7 vs. 5.3 percent (difference statistically significant at the one percent level). Within five years, it is almost twice: 18.6 vs. 10.3 percent (significant at the one percent level). These results are in accordance to those of Yung, Colak and Wang (2008). However, difference in failure rates decreases monotonically over time. Within 14 years from the IPO, failure rates are similar: 26.5 vs. 24.0 percent (with no statistical difference). In fact, the difference loses statistical significance after the 11^{th} year. Business cycles can explain difference in failure rates across cohorts: firms that went public during the bubble faced its burst just few months after their IPOs and a great credit crunch (2007-2009) within the first 10 years from their IPOs. Therefore, it is likely that the effect of macroeconomic shocks on failure rates is stronger for the bubble cohort. Summing up, there is no evidence of higher failure rates during the bubble in the long run.

Table 7 also reports the difference in failure rates across highly and lowly underpriced IPOs during the bubble. If underpricing is related to drop in quality, highly underpriced IPOs should be associated increases failure rate. We find just the opposite. Failure rate remains five to seven percent lower for highly underpriced IPO regardless of the time horizon (difference always statistically significant at the one percent level). Thus, failure rate seems negatively related to underpricing.

We also look at other quality measures: bid-ask spreads at the end of the second year from the IPO and analysts' coverage at the end of the first year, and institutional ownership and its Herfindahl index at the end of the second year from the IPO (Table 4, Panel C). Bid-ask spreads decreased from 4.2 to 3.2 percent and were considerably lower for highly underpriced firms: 2.4 vs. 3.9 percent. Analysts' coverage increased from 70 to 76 percent and was higher among highly underpriced IPOs: 80 vs. 73 percent. Institutional ownership was constant at 33 percent over both pre-bubble and bubble periods and it was slightly lower for highly underpriced IPOs: 31 vs. 34 percent (difference statistically significant at the 10 percent level). Similarly, the Herfindahl index was constant at 0.21 across periods and slightly lower for highly underpriced

IPOs: 0.20 vs. 0.22 (no statistical difference). Thus, once more we find no evidence for drop in quality.

Finally, we run regression analysis to search for drop in quality associated to issuers characteristics (Table 8). Initially we focus on VC-sponsorship. VC bubble firms were less frequently M&A targets, and they also experienced lower bid-ask spreads and institutional ownership. There was no relative change in failure rate, analysts' coverage and the Herfindhal index for institutional ownership. Therefore, VC-sponsorship at the bubble implies a higher liquidity and lower likelihood of becoming an M&A target. Thus, there is no evidence of a decrease in quality for VC-sponsored issuers. For pre-IPO acquirers there was increased likelihood of M&A, decreased bid-ask spreads and institutional concentration. Moreover, the failure among pre-IPO acquirers was so rare that the variable drops in failure regression. Consequently, apart from some evidence of industry concentration, all results point to an increase in quality. For issuers with Big-four auditing there was decreased failure rate, improved analyst coverage and institutional ownership, and lower institutional concentration. These results point towards an improvement in quality.

The only groups of firms for which we see any evidence of decrease in quality are technology and high-growth firms. Evidence is stronger for technology firms: there was an increase in the rate of failure, even though they had improved their liquidity (lower bid-ask spreads and higher analysts' coverage). High-growth firms experienced a reduction in institutional ownership and an increase in its concentration. For both technology and high-growth firms there was an indication of sector consolidation, with higher likelihood of becoming an M&A target.

Contrary to what one could expect, there is no evidence of any change in quality for young issuers during the bubble. Issuers that went public earlier in their life cycle during the bubble were equally good as their predecessors. This result goes against the idea that during the bubble firms were speeding up their IPOs to time the market and exploit investors' gullibility.

Overall, the evidence of a decrease in the quality of issuers seems weak. In particular, there is no evidence of deterioration in quality among VC-sponsored, acquiring, audited by Big-

four or young companies. This leaves little room for a demand-driven explanation for the high underpricing.

4.2.1.2 -- Change in underwriters'' certification

Certification increased during the bubble (Table 4). The proportion of top underwriting increased from 68 to 84 percent (difference significant at the one percent level), and was much higher among highly underpriced IPOs: 87 vs. 81 percent (significant at the five percent level). This led Loughran and Ritter (2004) to raise concern as top underwriting as measure of quality. Accordingly, the increase in top-underwriting during the bubble was due to top underwriters' opportunistic behavior to increase market share. We address such concern by running probit analysis on the probability of top underwriting (Model 5). Regressions 1-3 in Table 9 report marginal effects. Regression 1 includes only predetermined characteristics of issues. Top underwriting is more likely for VC-sponsored, technology and large firms, and for large offerings (in terms of absolute and relative size). Regression 2 includes a dummy variable for the bubble period. The marginal effect of the bubble dummy is -0.160 (statistically significant at the one percent level). Thus, the likelihood of any firm hiring a top underwriter fell by 16.0 percent during the bubble. Finally, Regression 3 also controls for issuers' strategic goals. The marginal effect of the bubble dummy remains the same both in terms of magnitude and statistical significance. In short, our results reject the idea of underwriters' opportunism. In fact, top underwriters became more selective. The increase in top underwriting during the bubble was due to the raise in the proportion of firms with the fit for it.

4.2.1.3 – Change in analysts' coverage

Loughran and Ritter (2004) suggest that during the bubble some firms coped with high underpricing to obtain analysts' coverage (*Analyst Lust*). We investigate such conjecture by running probit analysis on analysts' coverage (Model 5). Regressions 4-6 in Table 9 report marginal effects. Regression 4 controls for firms' characteristics, underpricing and the bubble period. The coefficient on underpricing is 0.020 and bears no statistical significance. The coefficient on the bubble dummy, -0.052, is statistically significant at the 10 percent level. The

marginal effect on Top-underwriting (0.055), even though positive and statistically significant at the 5% level is relatively small when compared to that of acquisition dummy (0.211 with t-statistics of 13.23) or VC sponsorship (0.133 with t-statistics of 7.18). Regression 5 also includes the interactions of underpricing and Top-underwriting with the bubble dummy. Both interactions are not statistically significant. Finally, regression 6 excludes Big-four auditing and Pre-IPO acquisition dummies, but results remain similar to those in regressions 4 and 5. Summing up, there is no evidence that during the bubble analyst coverage increased uniformly or that coverage was related to underpricing or top underwriting. Consequently, our results contradict the *Analyst Lust conjecture*.

5 – Conclusion

We conjecture that the Internet bubble and the concomitant high underpricing was consequence of the emergence of the Dotcom industry and its large cohort of firms racing for market leadership.

Our empirical findings support our conjecture. We begin by showing that during the bubble there was no decrease in the quality of the average issuer. In fact, there is indication that quality increased. For example, we find that the tradability conditions and certification improve during the bubble. Finally, in order to reconcile our result with the previous literature, we show that the increase in failure rate previously reported in the literature prevailed only in the short-run. However, the mid- and long-run failure rates are not different for the bubble and pre-bubble IPO cohorts. Furthermore, we observe that highly underpriced firms presented better quality than their low-underpriced counterparts. Therefore, our evidence goes against the *Risk Composition Hypothesis*.

By examining the determinants of top underwriting an analysts' coverage we found that underwriters and analysts became more selective during the bubble. Controlling for firms' characteristics, the likelihood of obtaining top underwriting fell by near 15 percent, while that of analysts' coverage fell by near three percent. Top underwriting and analysts' coverage increased during the bubble because of the increase in the proportion of firms with the fit for them. This

evidence is contrary to the *Analyst Lust Conjecture* and to the idea that top underwriters took advantage of the moment to increase their market share.

Next, we show that the abnormally high underpricing observed during the bubble can be fully accounted by issuers' characteristics and strategic purposes. The strategic dimensions we consider were firms that were doing acquisitions, sought Big-four auditing, and had VC sponsorship. The issuers associated with high underpricing were high-growth, technology and young. When one controls for these characteristics, it emerges that the abnormally high underpricing is not related to underwriters' behavior. Thus our evidence is contrary to the *Realignment of Incentives Hypothesis*.

We also checked for the possibility that investors forced high underpricing as a reaction to a decrease in quality for specific issuers. We did not find supporting evidence that firms with the characteristics associated to high underpricing presented decreased quality. The exception was technology firms that presented increased failure rates. Consequently, we do not find empirical support for the conjecture of a demand-driven high underpricing.

Finally, based on a model that controls for macroeconomic low-frequency shocks through the variation in NYSE composite index, we show that the number or proportion of highly underpriced IPOs explains large part of the variation on NASDAQ composite index. This result remains even if we proxy for the proportion of highly underpriced IPOs with the number of high-growth IPOs, or the number of IPOs with predicted high underprice (predictions coming from a regression that includes only issue's predetermined characteristics). This result is robust to the estimation period used to predict underpricing.

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Table 1
Variables Definition

Underpricing	The percent change from the IPO offer price to the closing price of the first trading day.
Acquisition post-IPO	Dummy variable indicating that the firm made acquisitions in the 5-year period after the IPO.
Acquisition pre-IPO	Dummy variable indicating that the firm made acquisitions in the 3-year period before the IPO.
Big-four auditing	Dummy variable indicating whether financial statements were audited by Big-Four auditor
Venture Capital (VC)	Dummy variable indicating VC sponsorship.
M&A	Dummy variable indicating that the firm was target for merger or acquisition between 3th and 10th years from the IPO.
Top underwriting	Dummy variable indicating whether the Carter-Manaster index (updated for the period 1992-2003 by Loughran and Ritter (2004) for the member of the underwriting syndicate with the highest score is bigger than 8.
Bid-ask spread	Difference between bid and ask prices, divided by the arithmetic average between the two.
Failure	Dummy variable indicating delisting for bankruptcy or drop.
Institutional ownership	Percentage of outstanding shares held by institutional investors.
Herfindhal index	Herfindhal index for institutional ownership.
Analysts' coverage	Dummy variable indicating that the firms is followed by at least one analyst during the year
Sales growth	Geometric average of quarterly sales growth during the last three quarters before the IPO (or available period if less).
High-growth	Dummy variable indicating that *Sales growth* was above the cut off for the top quartile using the sample from 1991-1996
Price revision up	Dummy variable indicating that the offer price was higher than original filing high price.
Price revision down	Dummy variable indicating that the offer price is lower than original filing low price.
Price interval	Original filing high price minus original filing low price divided by their average.
Offer size	Filled amount in the IPO prospectus (MM).
Firm size	Book value of assets in the last financial statement before the IPO (MM).
Technology	Dummy variable indicating technology industries as defined in Loughran and Ritter (2004).
Age	IPO year minus founding year.
Young	Dummy variable indicating if the firm is younger than 8.1 years old (the median age during the bubble).
Industry dummies	Mapped into US 2-digit SIC codes

Table 2
Reasons for drop in sample

Description	Number of IPO
Original Sample from Ritter (2014) sample including founding date	9003
IPOs missing prospectus and information from SDC Platinum	-2888
IPOs with multiple entries	-1
Firms without information on Institutional Holdings	-770
Firms without CRSP information on bid-ask spread	-60
Firms without Compustat Annual or Quarterly Fundamental's data	-1034
Firms with offer size less than US$ 5	-124
Firms that opened capital in unknown or foreign exchanges	-433
Firms with IPO after 2001	-880
Firms with IPO before 1990	-59
Total	**2754**

Table 3
Comparing samples

		Pre-bubble	Transition period		Bubble period	
		1991-1996	**1997**	**1998**	**1999**	**2000**
Sample	Ritter (2014)	2801	474	282	476	381
	Our Sample	1661	291	172	333	300
	coverage	58%	61%	61%	70%	79%
IPO at NASDAQ	Ritter (2014)	86%	79%	79%	92%	85%
	Our sample	88%	80%	73%	95%	94%
VC-backed IPOs	Ritter (2014)	37%	28%	27%	58%	64%
	Our sample	41%	33%	35%	63%	71%
Tech IPOs	Ritter (2014)	24%	58%	61%	78%	69%
	Our sample	29%	30%	28%	44%	57%
Gross Proceeds	Ritter (2014)	57.6	68.7	122.2	136.4	170.3
	Our sample	58.8	72.7	118	115.9	116.3
Median age	Ritter (2014)	8	7	6	4	5
	Our sample	8	9	7	5	6
Price revision up	Ritter (2014)	24.2%	24.2%	22.5%	47.7%	38.8%
	Our sample	27.0%	26.0%	25.0%	54.0%	38.0%
Price revision down	Ritter (2014)	27.0%	29.9%	28.0%	14.8%	22.1%
	Our sample	29.0%	32.0%	31.0%	17.0%	22.0%
Underpricing	Ritter (2014)	14.3%	14.0%	22.2%	71.7%	56.1%
	Our Sample	15.5%	15.1%	22.7%	75.1%	56.3%

Table 4

Characteristics of Sample across Periods

Underpricing: first trading day closing price relative to the offer price*; Age*: IPO year minus founding year; *Firm size*: book value of assets in the last financial report before the IPO; *Technology*: dummy variable indicating technology industries as defined in Loughran and Ritter (2004); *Sales growth:* geometric average of quarterly sales growth during the last three quarters before the IPO (or available period, if less); *High-growth*: dummy variable indicating quarterly sales growth above 100%; *Offer size:* filled amount in the IPO prospectus; and *Top underwriting*: dummy variable indicating that the Carter-Manaster index for the member of the underwriting syndicate with the highest score is bigger than 8. Number of firms with the attribute and t-statistics are in parentheses. *, ** and *** to denote statistical significance at the 10, 5 and 1percent levels (in **boldface**). The number or observations is 2,754.

	Panel A: entire sample				**Panel B: only growth firms (third quartile)**			
	Pre Bubble	**Transition period**	**Bubble Period**	**Difference**	**Pre Bubble**	**Transition period**	**Bubble Period**	**Difference**
	1991-1996	**1997-98**	**1999-2000**	**Bubble - Pre-bubble**	**1991-1996**	**1997-98**	**1999-2000**	**Bubble - Pre-bubble**
Sample	1660	464	633	-	211 (13%)	100 (22%)	261 (41%)	
Sales growth (Average of quarterly growth)	56%	68%	91%	**35%*** ** (0.000)				
Age	14.6	15.2	9.4	**-5.2*** (0.077)	9.03	10.61	6.07	**-2.96*** (0.077)
Technology	29%	30%	50%	**21%*** ** (0.000)	32%	33%	54%	**22%*** ** (0.000)
Firms size (Book value of assets in millions)	164.1	233.6	254.6	**90.5*** ** (0.000)	95	179	246	**151*** ** (0.000)
Offer size (in million)	58.8	95.35	116.1	**57.3*** ** (0.000)	53	103	112	**59*** ** (0.000)
Offer-to-firm size	1	1.09	1.12	**0.12*** ** (0.000)	1.17	1.27	1.12	-0.05 (0.488)
Big-four auditor	33%	31%	36%	**3%*** (0.082)	33%	33%	37%	**4%*** (0.082)
Acquisition pre-IPO (3 years)	33%	33%	25%	**-8%*** (0.094)	31%	21%	26%	**-5%*** (0.094)
Venture capital	41%	34%	67%	**26%*** ** (0.000)	57%	40%	77%	**20%*** ** (0.000)
Top underwriting	68%	67%	84%	**16%*** ** (0.000)	75%	73%	86%	**11%*** ** (0.000)
Underpricing	16%	20%	66%	**50%*** ** (0.000)	24%	29%	82%	**58%*** ** (0.000)

Table 5
The Price Spiral

Least squares estimations using Newey-West (12 lags) standard errors for the models $\Delta NASDAQ_t = \beta_0 + \beta_1 \Delta NYSE_t + \beta_2 \#IPOs\_Low_t + \beta_3 \#IPOs\_High_t + \varepsilon_t$ and $\Delta NASDAQ_t = \beta_0 + \beta_1 \Delta NYSE_t + \beta_2 \#IPOs_t + \beta_2 proprtion(IPOs\_High)_t + \varepsilon_t$, where Δ is the percent change in the index over period t; NASDAQ is the NASDAQ composite index and NYSE is the NYSE composite index. $\#IPOs_t$ is the number of IPOs in period t. $\#IPOs\_Low_t$ is the number of IPOs with low underpricing (or sales growth) in period t. $\#IPOs\_High_t$ is the number of IPOs with high sales growth in period t. Sample consists of 107 weeks from Jan/1999 to Dec/2000 (633 IPOs in this sample period). T-statistics are shown in parentheses. We use *, ** and *** to denote statistical significance at the 10, 5 and 1 percent levels (two sided).

	Bubble Period						**Bubble 1999**					
	Δ NASDAQ in 3 Weeks			**Δ NASDAQ in 1 Week**			**Δ NASDAQ in 3 Weeks**			**Δ NASDAQ in 1Week**		
Regression number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Δ NYSE (in 1 or 3 weeks)	**0.948***	0.935	0.954	**1.222*****	**1.206*****	**1.217*****	**1.556*****	**1.548*****	**1.641*****	**1.361*****	**1.347*****	**1.369*****
	(1.77)	(1.62)	(1.63)	**(3.68)**	**(3.55)**	**(3.55)**	**(11.21)**	**(12.98)**	**(15.13)**	**(9.28)**	**(10.64)**	**(10.61)**
# IPOs	0.001	**-0.007***	**-0.010*****	0.000	**-0.002***	**-0.004****	**0.004*****	**-0.005****	**-0.007*****	**0.003****	-0.000	-0.001
	(0.50)	**(-1.95)**	**(-2.71)**	(0.13)	**(-1.93)**	**(-2.51)**	**(2.77)**	**(-2.09)**	**(-2.68)**	**(2.46)**	(-0.20)	(-0.50)
Mean Sales Growth		**0.001***			**0.001****			**0.001*****			**0.001*****	
		(1.86)			**(2.07)**			**(4.00)**			**(3.17)**	
# high growth IPOs (75%)			**0.027*****			**0.010*****			**0.025*****			**0.008*****
			(2.85)			**(3.85)**			**(4.16)**			**(3.21)**
R-Squared	0.09	023	0.21	0.19	0.22	0.23	0.40	0.64	0.62	0.45	0.52	0.51
	Pre-bubble period (1990-1996)						**Transition period (1997-1998)**					
	13	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Δ NYSE (in 1 or 3 weeks)	**1.460*****	**1.461*****	**1.458*****	**1.385*****	**1.381*****	**1.380*****	**1.260*****	**1.297*****	**1.275*****	**1.262*****	**1.273*****	**1.267*****
	(10.21)	**(10.41)**	**(10.31)**	**(11.73)**	**(11.69)**	**(11.58)**	**(19.54)**	**(17.18)**	**(14.33)**	**(15.12)**	**(14.64)**	**(13.97)**
# IPOs	-0.000	0.001	0.001	-0.000	0.000	0.000	-0.001	-0.003	-0.002	-0.001	-0.001	-0.001
	(-0.42)	(1.05)	(1.18)	(-0.52)	(0.28)	(0.32)	(-0.71)	(-1.03)	(-0.57)	(-0.89)	(-1.22)	(-0.78)
Mean Sales Growth		-0.000			-0.000			0.000			0.000	
		(-1.6)			(-1.22)			(0.87)			(0.91)	
# high growth IPOs (75%)			-0.005			-0.002			0.004			0.001
			(-1.57)			(-1.06)			(0.36)			(0.37)
R-Squared	0.63	0.64	0.63	0.63	0.63	0.62	0.74	0.76	.075	0.73	0.74	0.73

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Table 6
Underpricing Analysis

Least square analysis of the underpricing. *Bubble dummy* indicates the years of 1999 and 2000; *Venture Capital* dummy: indicates VC sponsorship; *Top underwriting* dummy: indicates that the Carter-Manaster score for the highest syndicate member ≥ 8; *Big-four auditing dummy:* indicates Big-Four auditing; *High-growth* dummy: indicates quarterly sales growth ≥ 100%; *Acquisition pre-IPO* dummy: indicates acquisitions in the 3-year period before the IPO; *Young* dummy: indicates firm age ≤ 8.1 years; *Age*: IPO year minus founding year; *Technology* dummy: indicates technology industries as defined in Loughran and Ritter (2004); *Firm size*: book value of assets; *Offer size:* filled amount in the IPO prospectus; *Sales growth:* geometric average of quarterly sales growth over the last three quarters before the IPO (or available period if less); *Price interval*: original filing upper bound minus lower bound divided by their average; *Price Revision Up* dummy: indicates offer price higher than filing high price; and *Price Revision Down* dummy: indicates offer price lower than original filing low price. T-statistics in parentheses. Estimates use White standard errors. We use *, ** and *** to denote statistical significance at the 10, 5 and 1 percent levels (two sided). The number or observations is 2,754.

	1	2	3	4	5	6	7
Bubble dummy	**0.358*** (10.67)**	**0.249*** (3.67)**	0.074 (1.01)	-0.003 (-0.04)	-0.143 (-1.53)		**-0.173* (-1.88)**
Bubble x Top underwriting		**0.137* (1.77)**	0.087 (1.14)	0.084 (1.08)	0.065 (0.85)	-0.077 (-1.13)	0.083 (1.10)
Bubble x Non-top underwriting						-0.143 (-1.53)	
Bubble x Acquisition pre-IPO			**0.213*** (2.64)**	**0.229*** (2.85)**	**0.232*** (2.89)**	**0.232*** (2.89)**	**0.239*** (2.99)**
Bubble x Venture capital			**0.273*** (4.36)**	**0.270*** (4.31)**	**0.181*** (2.78)**	**0.181*** (2.78)**	**0.185*** (2.90)**
Bubble x Big-four				**0.217*** (2.97)**	**0.215*** (2.96)**	**0.215*** (2.96)**	**0.221*** (3.06)**
Bubble x High-growth					**0.134* (1.80)**	**0.134* (1.80)**	**0.146** (1.97)**
Bubble Dummy x Technology					**0.165** (2.47)**	**0.165** (2.47)**	**0.186*** (2.80)**
Bubble Dummy x Young					**0.130** (2.05)**	**0.130** (2.05)**	**0.129** (2.06)**
Acquisition pre-IPO	**0.072*** (3.74)**	**0.072*** (3.73)**	**0.023** (2.10)**	**0.074*** (3.88)**	**0.023** (2.14)**	**0.023** (2.14)**	0.014 (1.33)
Venture capital	**0.053*** (2.89)**	**0.054*** (2.97)**	-0.005 (-0.38)	**0.051*** (2.83)**	0.016 (1.35)	0.016 (1.35)	0.010 (0.95)
Big-four	**0.070*** (3.57)**	**0.071*** (3.60)**	0.018 (1.55)	**0.066*** (3.43)**	0.015 (1.29)	0.015 (1.29)	0.011 (1.06)
High-growth	**0.112*** (3.00)**	**0.110*** (2.95)**	**0.095*** (2.60)**	0.039 (1.35)	0.037 (1.29)	0.037 (1.29)	**0.047* (1.72)**
Technology	**0.088*** (4.04)**	**0.089*** (4.05)**	**0.085*** (3.91)**	**0.034** (2.55)**	**0.041*** (3.12)**	**0.041*** (3.12)**	0.019 (1.60)
Young	**0.045*** (2.72)**	**0.045*** (2.69)**	**0.039** (2.38)**	0.011 (0.88)	0.013 (1.07)	0.013 (1.07)	0.011 (0.98)
Top underwriting	**0.034* (1.75)**	0.010 (0.66)	**0.042** (2.22)**	**0.036* (1.91)**	**0.030** (2.18)**	**0.030** (2.18)**	0.028 (1.56)
Age	**-0.001** (-2.29)**	**-0.001** (-2.21)**	**-0.001*** (-2.84)**	**-0.001*** (-3.64)**	**-0.001*** (-3.86)**	**-0.001*** (-3.86)**	**-0.001*** (-2.81)**
Firm size	**0.056*** (4.13)**	**0.054*** (4.05)**	**0.052*** (4.11)**	**0.055*** (4.21)**	**0.051*** (4.14)**	**0.051*** (4.14)**	**0.047*** (3.80)**
Offer size	**-0.058*** (-3.62)**	**-0.054*** (-3.48)**	**-0.055*** (-3.59)**	**-0.054*** (-3.56)**	**-0.050*** (-3.48)**	**-0.050*** (-3.48)**	**-0.047*** (-3.34)**
Offer-to-firm size	10.754 (1.39)	10.734 (1.39)	10.602 (1.42)	10.395 (1.35)	10.256 (1.37)	10.256 (1.37)	9.852 (1.34)
Sales growth	0.042 (1.61)	**0.043* (1.66)**	**0.048* (1.86)**	**0.044* (1.69)**	**0.049* (1.92)**	**0.049* (1.92)**	0.028 (1.10)
Price interval	**-0.005*** (-3.68)**	**-0.005*** (-3.47)**	**-0.005*** (-3.40)**	**-0.006*** (-3.78)**	**-0.005*** (-3.45)**	**-0.005*** (-3.45)**	**-0.008*** (-6.03)**
Price revision up							**0.203*** (11.63)**
Price revision down							**-0.057*** (-6.65)**
R-squared	0.238	0.247	0.257	0.251	0.275	0. 275	0.301
Industry dummies	yes	yes	yes	yes	yes	Yes	yes
Constant	yes	yes	yes	yes	yes	Yes	yes

Table 7

Failure along firms life

Failure: dummy variable indicating delisting for bankruptcy or drop. Number of firms with the attribute and t-statistics are shown in parentheses. We use *, ** and *** to denote statistical significance at the 10, 5 and 1 percent levels (two sided). The number or observations is 2,754.

Cumulative Failure	**Pre Bubble**	**Transition period**	**Bubble Period**	**Difference**	**Bubble Period**		**Difference**
Years from the IPO	**1991-1996**	**1997-98**	**1999-2000**	**Bubble - pre-bubble**	**High Under>50%**	**Low Under≤50%**	**High-Low**
3	5.3% (88)	12.5% (58)	14.7% (93)	**9.4%***** **(0.000)**	10% (27)	9% (35)	1% (0.723)
4	7.6% (126)	18.3% (85)	16.7% (106)	**9.2%***** **(0.000)**	13% (34)	20% (72)	**-7%***** **(0.000)**
5	10.3% (171)	22.0% (102)	18.6% (118)	**8.3%***** **(0.000)**	15% (39)	21% (79)	**-7%***** **(0.000)**
6	12.7% (210)	24.1% (112)	19.7% (125)	**7.1%***** **(0.000)**	16% (42)	22% (83)	**-7%***** **(0.000)**
7	15.7% (260)	25.4% (118)	21.3% (135)	**5.7%***** **(0.000)**	18% (48)	24% (87)	**-5%***** **(0.000)**
8	17.5% (291)	26.1% (121)	22.6% (143)	**5.1%**** **(0.034)**	20% (52)	25% (91)	**-5%***** **(0.000)**
9	19.4% (322)	26.9% (125)	24.2% (153)	**4.8%**** **(0.027)**	22% (57)	26% (96)	**-5%***** **(0.000)**
10	20.5% (341)	27.8% (129)	25.1% (159)	**4.6%*** **(0.082)**	22% (57)	28% (102)	**-6%***** **(0.000)**
11	20.5% (341)	27.8% (129)	25.1% (159)	**4.6%*** **(0.091)**	22% (58)	28% (103)	**-6%***** **(0.000)**
12	22.6% (375)	29.7% (138)	25.8% (163)	3.2% (0.124)	23% (60)	28% (105)	**-6%***** **(0.000)**
13	23.5% (390)	30.2% (140)	26.2% (166)	2.7% (0.132)	23% (61)	28% (105)	**-5%***** **(0.000)**
14	24.0% (399)	30.8% (143)	26.5% (168)	2.5% (0.133)	24% (63)	28% (105)	**-5%***** **(0.000)**
15	24.3% (404)	31.0% (144)	26.5% (168)	2.2% (0.137)	24% (63)	28% (105)	**-5%***** **(0.000)**

Table 8
Quality Analysis
(Marginal effects)

The dependent variables are *Failure*: dummy variable indicating delisting for bankruptcy of drop in the first 10 years from the IPO; M&A: dummy variable indicating that the firm was target for acquisition in the first 10 years from the IPO; Bid-ask: bid-ask spreads at the end of the second year from the IPO; Analysts: dummy variable indicating analysts coverage at the end of the second year from the IPO; *Institutional ownership*: Percentage of outstanding shares held by institutional investors at the end of the second year from the IPO; and *Herfindhal*: Herfindhal index for institutional ownership at the end of the second year from the IPO. Explanatory variables are: *Bubble dummy* indicates the years of 1999 and 2000; *Venture Capital*: dummy variable indicating VC sponsorship; *Acquisition pre-IPO:* dummy variable indicating that the firm made acquisitions in the 3-year period before the IPO; *Big-four auditing*: dummy variable indicating auditing by Big-Four auditors; *High-growth*: dummy variable indicating quarterly sales growth above 100%; *Technology*: dummy variable indicating technology industries as defined in Loughran and Ritter (2004); *Young*: dummy variable indicating if the firm is younger than 8.1 years old; Age: IPO year minus founding year; *Firm size*: book value of assets in the last financial report before the IPO; *Offer size:* filled amount in the IPO prospectus; and *Sales growth:* geometric average of quarterly sales growth during the last three quarters before the IPO (or available period if less). T-statistics are shown in parentheses. Estimates use White standard errors. We use *, ** and *** to denote statistical significance at the 10, 5 and 1 percent levels (two sided). The number or observations is 2,754.

	Failure	**M&A**	**Bid-Ask**	**Analysts**	**Institutional ownership**	**Herfindhal**
Bubble dummy	0.065	-0.083	**-0.010*** **	**-0.207*** **	-0.026	**0.078*** **
	(1.36)	(-1.55)	**(-7.00)**	**(-3.96)**	(-0.82)	**(3.17)**
Bubble x Venture capital	-0.010	**-0.095** **	**-0.003***	-0.033	**-0.079*** **	0.010
	(-0.24)	**(-1.99)**	**(-1.81)**	(-0.65)	**(-2.73)**	(0.39)
Bubble x Acquisition pre-IPO	dropped	**0.200*** **	**-0.002***	0.050	0.012	**-0.053** **
		(3.20)	**(-1.88)**	(0.97)	(0.47)	**(-2.49)**
Bubble x Big-four	**-0.067***	0.098	-0.001	**0.135*** **	**0.046***	**-0.047** **
	(-1.93)	(1.56)	(-0.80)	**(3.62)**	**(1.79)**	**(-2.07)**
Bubble x High-growth	-0.023	**0.116***	0.002	-0.087	**-0.067** **	**0.073*** **
	(-0.54)	**(1.75)**	(1.32)	(-1.58)	**(-2.47)**	**(2.84)**
Bubble x Technology	**0.095** **	**0.120** **	**-0.004*** **	**0.104*** **	-0.002	0.025
	(2.02)	**(2.05)**	**(-2.99)**	**(2.59)**	(-0.07)	(1.07)
Bubble x Young	0.013	-0.080	-0.001	0.036	-0.003	0.009
	(0.27)	(-1.54)	(-0.95)	(0.73)	(-0.09)	(0.37)
Venture capital	-0.034	**0.060** **	-0.000	**0.155*** **	**0.088*** **	**-0.066*** **
	(-1.64)	**(2.54)**	(-0.31)	**(6.79)**	**(7.91)**	**(-6.61)**
Acquisition pre-IPO	dropped	**0.601*** **	-0.000	**0.294*** **	**0.063*** **	**-0.056*** **
		(30.01)	(-0.52)	**(15.71)**	**(5.77)**	**(-6.24)**
Big-four	-0.020	**-0.183*** **	0.000	0.005	**0.029*** **	**-0.032*** **
	(-1.01)	**(-8.45)**	(0.07)	(0.22)	**(2.60)**	**(-3.51)**
High-growth	**0.114*** **	-0.046	-0.002	0.014	**-0.067*** **	**0.041** **
	(2.91)	(-1.18)	(-1.27)	(0.35)	**(-3.34)**	**(2.39)**
Technology	**-0.083*** **	-0.021	-0.000	**-0.046***	**-0.026** **	0.014
	(-3.63)	(-0.85)	(-0.45)	**(-1.80)**	**(-2.25)**	(1.24)
Young	**0.047** **	0.002	0.000	**-0.089*** **	-0.017	**0.020***
	(2.05)	(0.09)	(0.32)	**(-3.53)**	(-1.36)	**(1.91)**
Age	-0.000	-0.000	0.000	-0.000	**0.001** **	**-0.001*** **
	(-0.52)	(-0.18)	(1.10)	(-0.39)	**(1.97)**	**(-2.84)**
Firm size	-0.007	**0.025***	**-0.002*** **	-0.015	0.011	**-0.022*** **
	(-0.62)	**(1.82)**	**(-3.38)**	(-1.10)	(1.62)	**(-4.29)**
Offer size	**-0.057*** **	-0.025	**-0.004*** **	**0.060*** **	**0.074*** **	**-0.059*** **
	(-4.15)	(-1.51)	**(-5.57)**	**(3.54)**	**(9.34)**	(-9.12)
Offer-to-firm size	4.335	1.100	0.361	1.659	**-4.512*** **	-0.965
	(1.12)	(0.19)	(0.79)	(0.41)	**(-2.60)**	(-0.52)
Sales growth	**-0.066** **	0.036	-0.001	**0.061** **	**0.041*** **	**-0.049*** **
	(-2.47)	(1.17)	(-1.27)	**(2.06)**	**(2.85)**	**(-3.58)**
R-squared			0.333		0.165	0.188
Industry dummies	yes	yes	yes	yes	yes	Yes
Constant	yes	yes	yes	yes	yes	Yes

Table 9
Determinants of Top Underwriting and Analysts' Coverage
(Marginal effects)

The dependent variables are *Top underwriting*: dummy variable indicating that the Carter-Manaster index for the member of the underwriting syndicate with the highest score is bigger than 8; and *Analysts' coverage*: dummy variable indicating that the firms was followed by at least one analyst in the second year from the IPO; *Bubble dummy* indicates the years of 1999 and 2000; *Acquisition pre-IPO:* dummy variable indicating that the firm made acquisitions in the 3-year period before the IPO; *Venture Capital*: dummy variable indicating VC sponsorship; *Big-four auditing*: dummy variable indicating auditing by Big-Four auditors; *Age*: IPO year minus founding year; *Technology*: dummy variable indicating technology industries as defined in Loughran and Ritter (2004); *Firm size*: book value of assets in the last financial report before the IPO; *Offer size:* filled amount in the IPO prospectus; and *Sales growth:* geometric average of quarterly sales growth during the last three quarters before the IPO (or available period, if less). T-statistics are shown in parentheses. Estimates use White standard errors. We use *, ** and *** to denote statistical significance at the 10, 5 and 1 percent levels (two sided). The number or observations is 2,754.

	Top underwriting			**Analyst's Coverage in year 1**		
	1	**2**	**3**	**4**	**5**	**6**
Bubble Dummy		**-0.160*** **	**-0.157*** **	**-0.052***	-0.046	**-0.063***
		(-5.23)	**(-5.12)**	**(-1.72)**	(-1.38)	**(-1.84)**
Underpricing x Bubble					-0.021	-0.030
					(-0.40)	(-0.55)
Top underwriting x Bubble					0.033	0.026
					(1.33)	(1.04)
Underpricing				0.020	0.036	0.052
				(0.96)	(0.75)	(1.03)
Acquisition pre-IPO			**0.036***	**0.211*** **	**0.211*** **	
			(1.95)	**(13.23)**	**(13.21)**	
Big-four auditing			0.012	**-0.035***	**-0.035***	
			(0.66)	**(-1.88)**	**(-1.89)**	
Venture capital	**0.160*** **	**0.173*** **	**0.171*** **	**0.133*** **	**0.133*** **	**0.135*** **
	(8.93)	**(9.58)**	**(9.47)**	**(7.18)**	**(7.18)**	**(7.19)**
Top underwriting				**0.055** **	0.037	**0.058** **
				(2.15)	(1.56)	**(2.30)**
Age	-0.001	**-0.001***	**-0.001***	0.001	0.001	0.001
	(-1.31)	**(-1.72)**	**(-1.71)**	(1.50)	(1.52)	(1.45)
Technology	**0.049** **	**0.061*** **	**0.059*** **	0.015	0.015	0.027
	(2.42)	**(3.06)**	**(2.95)**	(0.75)	(0.74)	(1.35)
Firm size	**0.118*** **	**0.124*** **	**0.124*** **	-0.018	-0.018	-0.014
	(8.36)	**(8.63)**	**(8.57)**	(-1.49)	(-1.48)	(-1.18)
Offer size	**0.195*** **	**0.219*** **	**0.219*** **	**0.065*** **	**0.065*** **	**0.064*** **
	(10.87)	**(11.50)**	**(11.45)**	**(4.20)**	**(4.21)**	**(4.21)**
Offer-to-firm size	**9.480***	**10.187***	**10.274***	-1.740	-1.721	-1.916
	(1.77)	**(1.82)**	**(1.83)**	(-0.47)	(-0.47)	(-0.53)
Sales Growth	0.010	0.027	0.028	**0.043** **	**0.043** **	**0.040** **
	(0.48)	(1.34)	(1.40)	**(2.23)**	**(2.18)**	**(1.98)**
Industry dummies	yes	yes	yes	yes	yes	yes
Constant	yes	yes	yes	yes	yes	yes