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Dotcom Price Spiral

Antonio Gledson de Carvalho,
Roberto B. Pinheiro, and
Joelson Oliveira Sampaio

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Antonio Gledson de Carvalho, Roberto B. Pinheiro, and Joelson Oliveira Sampaio

We show that during the bubble implied growth rates coming from the underpricing of IPO market explains short term returns on the NASDAQ index. This result remains even if we replace actual underprice for others different instruments for underpricing that are based on predetermined variables and not correlated to market returns. We also do placebo tests to assess the relation between underpricing and NASDAQ returns over other periods. We show that growth proxies that are not contaminated by the booms and busts of the stock market are uncorrelated with the returns on the NASDAQ index in periods outside the bubble.

Keywords: Internet bubble, underpricing, spinning, analyst lust, risk composition hypothesis.
JEL codes: G14, G24, L1, O33.

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Antonio Gledson de Carvalho is at Fundação Getulio Vargas, School of Business at São Paulo (gledson.carvalho@fgv.br.); Roberto B. Pinheiro is at the Federal Reserve Bank of Cleveland (roberto.pinheiro@clev.frb.org); and Joelson Oliveira Sampaio is at Fundação Getulio Vargas, School of Economics at São Paulo (joelson.sampaio@fgv.br). The authors thank Charles Calomiris, Marcelo Fernandes, Tim Loughran, George Pennacchi and seminar participants at the University of São Paulo, Nova School of Business and Economics, WHU Otto Beischeim School of Management, and Luso-Brazilian Finance Network 2017 and International Economic Association Meeting 2017 for invaluable comments. They acknowledge Humberto Gallucci Netto and Pedro Luiz Aprigio for their excellent research assistance. Carvalho acknowledges support from FAPESP [2016-06826-6].

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1 – Introduction

The NASDAQ composite index escalated from 2,000 points in the beginning of 1999 to 5,048 points in March 2000, returning to near the 2,000 points after 2000. A similar trend did not occur is other stocks exchange. For instance, along 1999 and 2000 the New York Stock Exchange Composite index (NYSE) varied between 6,092 and 7,164 (Graph 1 shows the evolution of NASDAQ and NYSE composite indices). The unusual rise and fall in the prices of technology stocks has led many academics and practitioners to describe such event as a stock price bubble.[1]

Some studies conjecture that high expectations about growth rates caused the high valuations of technology stocks. Schwartz and Moon (2000) observe that high valuation could follow from revenue growth that is both sufficiently high and sufficiently volatile. They calibrate their model to match the valuation of Amazon.com, but they report that the implied return volatility is too high and that the implied revenue distribution is unrealistic. Ofek and Richardson (2002) argue that the earnings of Internet firms would have to grow at implausibly high rates to justify the Internet stock prices of the late 1990s. Pastor and Veronesi (2006) show that a firm's fundamental value increases with uncertainty about average future profitability. Thus, high valuation could come for a combination of high growth and high volatility. By calibrating a stock valuation model, they find that the implied volatility matches the high volatility of NASDAQ stock prices.[2]

If one wants to stick to the idea that the high valuation was consequence of high growth, one needs to explain the source of expectations and volatility on growth rates. Table 4 shows that weekly returns on NASDAQ and NYSE indices. The returns on NASDAQ are much more

[1] See, for example, Thaler (1999), Shiller (2000), Ofek and Richardson (2002, 2003), Ritter and Welch (2002), Abreu and Brunnermeier (2003), Brunnermeier and Nagel (2004), Ljungqvist and Wilhelm (2003).

[2] There were some other attempts to provide rational explanations for the high valuations of technology stocks in the late 1990s. Ofek and Richardson (2003) argue that valuations were high due in part to short-sale constraints. Cochrane (2003) argues that technology stocks were valued highly because they offered high convenience yields. However, neither study demonstrates that the magnitudes of these effects could be sufficiently large to justify the observed valuations of NASDAQ firms.

volatile than on NYSE. Weekly returns on NASDAQ changed from 0.1 percent mean and 0.33 percent standard deviation in 1997-1998 to 0.37 percent mean and 9.25 percent standard deviation. If expectations on growth rate were causing such volatility, there should have been a continuous flow of new information on growth rates. However, data on actual sales growth for public firms are not continuous. They come quarterly and often coincide in time across firms. Therefore, information on growth could not come from balance sheets. We conjecture that the IPOs market provided the necessary continuous flow of information on growth rates.

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). Such wave of innovation even raised doubt on whether these new businesses would subsume traditional ones. Thus, the growth rate of New Economy firms was informative for a wide range of businesses. New Economy firms going public presented abnormal realized growth rate, but their tracking record was short because they were young. Short tracking 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 IPO market, through the growth rate implied in their underpricing provided a continuous flow of information on growth rates.[3] The stock of public New Economy firms was small and the flow of IPOs was large. Thus, the IPO market was relevant to assess the long-term growth rate of the stock of firms and, consequently, of a wide variety of industries. The continuous flow of highly underpriced/high-growth IPOs lead investors to update upwards their estimated long-term growth rate, causing upward price revision for the whole industry. Furthermore, not all IPOs were highly underpriced. During the bubble the lowest underpricing was -26%. The variance in underpricing could have been the source of volatility. Necessary to say, by conjecturing that the IPO market was informative we do not deny that other sources of information such as earnings announcements played a role in explaining returns and volatility.

[3] Ritter (2004) lists 857 IPO in 1999-2000, which in average yields more than 8 IPOs a week.

We present evidence supporting our conjecture. We show that during the bubble the flow of IPOs of highly underpriced IPOs (high-implied growth rate) explains returns on the NASDAQ composite index. Such result remains even if we replace actual underprice for others different instruments for underpricing that are based on predetermined variables and not correlated to market returns. We also do placebo tests to assess the relation between underpricing and NASDAQ returns over other periods besides the bubble.

This article is also related to the theoretical literature on asset bubbles, e.g., Tirole (1985), Allen and Gorton (1993), Santos and Woodford (1997), Abreu and Brunnermeier (2003), Allen, Morris, and Shin (2003), and Scheinkman and Xiong (2003). Garber (2000) proposes rational explanations (unrelated to ours) for the Dutch tulip mania of the 1630s and other historical "bubble" episodes. Donaldson and Kamstra (1996) develop a neural network model for dividends, and use it to dismiss the idea of a stock price bubble in the 1920s. Note that we do not claim that investor behavior in the late 1990s was fully rational. Good examples of apparent irrationality are presented by Cooper, Dimitrov, and Rau (2001), Lamont and Thaler (2003), and others. We also do not attempt to rule out any behavioral explanations for the "bubble." Rather, we only argue that such explanations may not be necessary because stock prices in March 2000 appear to be consistent with a rational explanation.

This article is structured as follows: Section 2 presents our model. Section 3 describes variables, data and econometric models. Section 4 presents our results. Section 5 concludes.

2 – Model

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 new technology could induce high growth, g_H, or low growth rates, g_L ($g_H > g_L$). Investors a priori do not know the actual 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.

3 – Variables, data and econometric models

3.1 – Variables

Table 1 described variables. Panel A list our macroeconomic variables, all of which are measured over one or three-week period. These variables are variation on NASDAQ or NYSE composite indices (*Δ NASDAQ* and *Δ NYSE*); *Number of IPOs* in the period; *Mean actual underpricing*: weighted average of underpricing with weights based on gross proceeds. In our analysis, underpricing is a signal for forecasted growth. However, booms and busts of the stock market as a whole can contaminate the underpricing of individual IPOs. To control for such contamination, we create some variables that, although correlated to underpricing, are unlikely to be contaminated by current or recent market movements. These variables are: *mean sales growth*: weighted average of realized sales growth of individual IPOs. This measure presumes that investors project that the historical sales growth into the future; *mean predicted underpricing*: individual predicted underpricing comes from econometric model:

$$\widehat{Underpricing}_l = \hat{\alpha} + \hat{\gamma} Issue_l,$$

where

$Issue_l$ is a vector of issue's characteristics: VC-sponsorship, Big-four auditing, sales growth, technology industry, age, firm size, offer size, offer-to-firm size, the size of the price interval scaled by its middle point and past M&A activities; and

$\hat{\alpha}$ and $\hat{\gamma}$ are estimated coefficients from the regression

$$Underpricing_l = \hat{\alpha} + \hat{\gamma} Issue_l + \epsilon_i$$

Applied on the sample of IPOs from the pre-bubble period (1991-1996);

Mean residual underpricing 1: individual residual underpricing is the estimated error term of an underpricing regression on several measures of recent market performance. In particular, our measure controls for the fluctuations in the stock market in the IPO period and past performance, i.e., we estimate the expected underpricing by the following econometric model:

$$\widehat{Underpricing}_t = \alpha + \sum_i \beta_i \Delta NASDAQ_{t-i} + \sum_j \theta_j \Delta NYSE_{t-j} + \varepsilon_t$$

where the lags in the variation of the NASDAQ and NYSE indexes include the periods of 1,2, and 3 weeks, 1 to 6 months, and 1 year. Therefore, our measure is given by:

$$Residual\ Underpricing\ 1_t = Underprincing_t - \widehat{Underprincing}_t;$$

Mean residual underpricing 2: R*esidual underpricing 1* takes into account market and business cycle variations but ignores individual IPO characteristics that may affect underpricing. *Residual underpricing 2* also control for IPOs characteristics. We estimate the expected underpricing with the econometric model:

$$\widehat{Underpricing}_{2,t} = \hat{\alpha} + \sum_i \hat{\beta}_i \Delta NASDAQ_{t-i} + \sum_j \hat{\theta}_j \Delta NYSE_{t-j} + \hat{\gamma} Issue_l$$

And

$$Residual\ Underpricing\ 2_t = Underprincing_t - \widehat{Underpricing}_{2t};$$

Where

$\hat{\alpha}$, $\hat{\beta}$, $\hat{\theta}$ and $\hat{\gamma}$ are estimated coefficients from the regression using the whole sample period (1991-2000).

Panel B list our microeconomic (individual) variables: Most of these variables are standard in the underpricing literature: *Gross proceeds, Assets size*, *Technology industries*, *Firms' age at IPO*, Sales *growth*, *initial price interval*, *Venture capital sponsorship*, top underwriting and *Big-four auditing*. The only new variable is *Acquisition pre-IPO*: a dummy variable indicating that the issuer made acquisitions in the 3-year period before the IPO. 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 an extended period, Celikyurt, Sevilir, and Shivdasani (2010) report that newly public firms make acquisitions at a torrid pace. 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.

3.2 – 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 Panel A compares our sample to that of Ritter (2014). Across periods, our sample is smaller than Ritter (2004). Overall, our sample comprises 62 percent of his sample. This could be due to our need for micro data such as sales growth that rules out IPOs of firms without sales records. During the pre-bubble and transition periods, our coverage is 59 and 61 percent of his sample. During the bubble period, the coverage increases to 74 percent. Samples are similar across periods 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 (mainly during the bubble). 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 (mainly because our data tends to exclude start-ups).

Table 3 Panels A and B also presents averages for our microeconomic variables across periods. The general message is that IPO characteristics changed sharply from the pre-bubble to the bubble period. From Panel A, the proportion of VC sponsored IPOs increased from 41 to 67 percent. The fraction of IPO from technology firms increased from 29 to 50 percent. Gross proceeds increased from US$ 58.8 mi to 116.1 mi. Issuers median age declined from 8 to 5 years. Finally, underpricing increased from 15.5 percent to 66 percent. In Panel B one can see that sales growth (measured by the average quarterly growth over the previous three quarters) increased significantly from 56 percent in the pre-bubble to 91 percent in the bubble. Firm size (measured by book value of assets) increased from $164 to $255 mi. Offer size increased from $58 million to $116 million. The proportion of IPOs underwritten by top tier investment banks increased from 68 to 84 percent. Big-four auditing remained reasonably stable around 31 to 36 percent. Finally, Pre-IPO acquisitions dropped from 33 to 25 percent.

Table 4 presents basics statistics on our macroeconomic variable. To keep the discussion simple we compare only the Bubble-restricted period to the Pre-bubble. Returns were significantly higher at NASDAQ during the bubble: 2.17 versus 0.1 percent. Returns were also higher at NYSE but difference was moderate: 0.45 versus 0.07 percent. Volatility (standard deviation) was also much higher at NASDAQ (8.95 versus 0.33 percent) than in NYSE (3.62 versus 0.20 percent). These values imply that the coefficient of variation increased from 3.3 to 4.1 at NASDAQ and from 2.9 to 8.5 at NYSE. Thus, volatility increased in both markets. Weighted mean sales growth for IPO firms jumped from 3.33 to 6.63 percent. Mean actual underpricing increased from 12.2 to 25.72 percent (this value during the bubble are much lower than the unweighted average that was above 60 percent). Mean predicted underpricing during the bubble is significantly lower than the actual because the parameters used to construct this variable reflects the pre-bubble period. Finally mean residual underpricing 1 significantly higher than mean residual underpricing 2 because in the first case the residual are liquid of market variations while in the second, of market variations and individual IPOs characteristics.

Table 5 presents correlations among macroeconomic variables across the four periods that we defined. One can see that statistical significance does not depend on the period. The most relevant information is that all the proxies for expected growth are positively correlated and usually statistical significant at the one percent level. The only exception is the correlation between Mean predicted underpricing and Mean residual 1 which is not statistically significant. Returns on NASDAQ and NYSE are positively correlated and statistically significant at the one percent level in all periods, although such correlation is significantly lower during the bubble period. Mean predicted underpricing is the only other variable to which Returns on NASDAQ correlates. This correlation is stronger during the pre-bubble period, but this was expected since the pre-bubble sample was used to obtain the coefficients used to calculate predicted underpricing. The number of IPOs is positively correlated to mean sales growth and mean predicted underpricing. It is important to notice that the correlations between the Mean residual underpricing 1 and 2 with the market indices are virtually null, indicating that the procedure we used in fact eliminated reverse causality issues. Similarly, the correlation between market indices and mean sales growth is virtually null, showing that reverse causality is not an issue for sales growth as proxy for expected growth.

3.3 – Econometric models

We claim that, during the bubble, returns on the NASDAQ composite index responded to the underpricing of 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. We also control for the activity in the IPO market, both in terms of the number of IPOs in period t, as well as the average underpricing.

[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%).

Moreover, we control for proxies of the presence of high growth opportunities through measures of high underpricing and high growth. In particular our econometric models are

$$\Delta NASDAQ_t = \beta_1 \Delta NYSE_t + \beta_2 \#IPOs_t + \beta_3\, Expected\ growth_t + \varepsilon_t \quad (1)$$

where

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

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

$Expectd\ growth_t$: several proxies for expected growth in period t (*Mean actual underpricing, Mean predicted underpricing, Mean sales growth, Mean residual underpricing 1* and *Mean residual underpricing 2.*

We estimate Model 1 using both weekly returns and three-week rolling returns. Estimations come from least squares regressions with Newey-West (12 lags) standard errors (Newey and West, 1987).

4 – Results

Table 6 presents estimations for Model 1 to analyze the effect of expected growth rates extracted from the IPO market on the NASDAQ composite index. Panel A focuses on the bubble period. We consider two sub-periods: the Bubble restricted (1999 to March/2000) and Bubble extended (1999-2000), the latter including the burst of the bubble. Overall, the results in Panel A corroborate the conjecture that expected growth rates implied in the valuation of IPOs explain the variation in NASDAQ composite index returns during the bubble.

Regression 1A considers three-week rolling returns during the Bubble restricted. It includes only ΔNYSE and the number of IPOs. The coefficient on ΔNYSE composite index is 0.948 (near to one as expected) although its statistical significance is only marginal (t-statistics is 1.77). The coefficient on the number of IPOs is virtually zero in magnitude and statistical significance. R-square coefficient is only 0.21. Results for this specification are similar if one considers other periods or return metrics, even though the magnitude and statistical significance of the coefficient on ΔNYSE and R-square vary (Regressions 2A to 8A).

All the remaining regressions in Panel A include a proxy for expected growth. Regression 1B, 2B, 3B and 4B include actual mean underpricing. In Regression 1B, for example, the three regressors are statistically significant at the one percent level. The coefficient on ΔNYSE remains close to one. The coefficient on the number IPOs becomes negative and statistically significant. The coefficient on the weighted mean of actual underpricing is 0.005.[5] R-square coefficient almost doubles, reaching 0.4. Results for Regressions 2B, 2C and 2D are similar. Over the Bubble restricted period, all the proxies for expected growth turn out to be statistically significant.

As Regressions 2B and 4B are on weekly returns, there is an economic interpretation for the coefficients on the mean of actual underpricing. For instance, in Regression 2B the coefficient is 0.003 and the weekly mean underpricing is 25.72% (from Table 4). This indicates a variation of 0.003 × 24.72 = 0.77 percent a week. Over the period of 75 weeks of the Bubble restricted period, this implies accumulated returns of 57.8 percent. Over the same period, NASDAQ composite index went from 2,208 to 4,784 points, representing an appreciation of 117 percent. Thus, the effect of the actual underpricing is sizable.

As expected, over the Bubble extended period (1999-2000), the statistical significance of the explanatory variables tends to be smaller. This was expected: along 2000 there was the burst of the bubble and its last months were not properly part of the bubble period. Actual underpricing and sales growth remain statistically significant in all circumstances. Predicted underpricing, Residual underpricing 1 and 2 are only statistically significant for three-week periods (Regressions 3C, 3E, and 3F).

To remind the reader, we argue that during the bubble the IPO market was relevant to assess the long-term growth rate of the New Economy (and other industries), because the stock of public firms in the sector was small and the flow of IPOs was large. This is not true for the pre-bubble and transition periods. Thus, we expect that implied growth rates coming from the IPO market do not affect market valuation out of the bubble.

[5] The interpretation of the economic magnitude of this coefficient is not straightforward because it is based on rolling periods.

Panel B presents placebo tests, in which we evaluate the behavior of our proxies for growth out of the bubble. The overall picture is that actual mean underpricing (Regression 5B to 8B) and predicted mean underpricing (5C to 8C) are still statistically significant to explain stock market fluctuations in the pre-bubble and transition periods. Sales Growth and Residual underpricing 1 and 2 are not statistically significant. In fact, for these three variables coefficients are small in magnitude and statistical significance.

In Regressions 5B to 8B and 5C to 8C, both the actual mean underpricing and predicted mean underpricing are still correlated with stock market fluctuations in the pre-bubble and transition periods. One possible issue is that booms and busts in the stock market contaminate these proxies for growth opportunities, for example. Differently, sales growth and our constructed measures of residual mean underpricing are uncorrelated with market movements in the pre-bubble period. The effect of the actual and predicted underpricing was already expected. As discussed before the booms and busts of the stock market as a whole can contaminate the actual underpricing of individual IPOs. Predicted underpricing were estimated using IPOs individual characteristics and the pre-bubble period as basis to obtain parameters. This procedure does not control for market timing in which certain firms choose to go public in hot markets. On the other hand, the clean result obtained for the variables that are not contaminated by contemporaneous market returns strongly suggests that implied growth rates coming from the IPO market do not affect overall market valuation.

5 – Conclusion

We conjecture that the Internet bubble and the concomitant high underpricing was consequence of the emergence of the Dotcom industry and the introduction of disruptive, high growth technologies. We show that, during the bubble, proxies for high-expected growth explain returns on the NASDAQ composite index. In our empirical strategy, we proxy for expected growth using both actual and predicted mean underpricing, sales growth, and constructed measures of mean underpricing that attempt to net underpricing from boom and bust movements of the overall stock market. We also control for macroeconomic low-frequency shocks through the variation in NYSE composite index. Moreover, we show that growth proxies that are not

contaminated by the booms and busts of the stock market as a whole are uncorrelated with the returns on the NASDAQ composite index in periods outside the bubble. These results strongly suggest that implied growth rates coming from the IPO market explain, at least partially, NASDAQ valuation during the bubble.

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Table 1

Variables Definition

Panel A: Macroeconomic variables (over one week or three week periods)	
Δ NASDAQ	Percent change in the NASDAQ composite index over a determined period.
Δ NYSE	Percent change in the NYSE composite index over a determined period.
Number of IPOs	Number of IPOs in the week
Mean actual underpricing	Weekly underpricing average (variable weighted by gross proceeds)
Mean sale growth	Weekly sales growth average (variable weighted by gross proceeds)
Mean predicted underpricing	Prediction based on IPO characteristics and parameters obtained in the pre-bubble period (1991-1996) (variable weighted by gross proceeds)
Mean residual Underpricing 1	Individual residual underpricing is the estimated error of a regression of underpricing on market returns over several periods (variable weighted by gross proceeds)
Mean residual Underpricing 2	Individual residual underpricing is the estimated error of a regression of underpricing on market returns over several periods and IPO characteristics (variable weighted by gross proceeds)
Panels B: microeconomic variables (individual IPOs)	
Underpricing	The percent change from the IPO offer price to the closing price of the first trading day.
Offer size	Filled amount in the IPO prospectus (US$ mi).
Firm size	Book value of assets in the last financial statement before the IPO (US$ mi).
Offer-to-firm size	Offer sized divided by firm size
Technology	Dummy variable indicating technology industries as defined in Loughran and Ritter (2004).
Age	IPO year minus founding year.
Sales growth	Geometric average of quarterly sales growth during the last three quarters before the IPO (or available period if less).
Price interval	Original filing high price minus original filing low price divided by their average.
Venture Capital (VC)	Dummy variable indicating VC sponsorship.
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.
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
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

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.

		Pre-bubble	**Transition period**	**Bubble period**	**Bubble period-S**
		1991-1996	**1997-1998**	**1999-2000**	**1999-03/2000**
Panel A (comparing samples)					
Sample	Ritter (2014)	2801	756	857	583
	Our Sample	1660	463	633	421
	coverage	59%	61%	74%	72%
IPO at NASDAQ	Ritter (2014)	86%	79%	89%	90%
	Our sample	88%	77%	95%	94%
VC-backed IPOs	Ritter (2014)	37%	28%	61%	64%
	Our sample	41%	34%	67%	67%
Tech IPOs	Ritter (2014)	24%	59%	74%	72%
	Our sample	29%	29%	50%	48%
Gross Proceeds	Ritter (2014)	57.6	88.5	151.7	140.3
	Our sample	58.8	89.5	116.1	110.2
Median age	Ritter (2014)	8	7	4	4
	Our sample	8	8	5	5
Price revision up	Ritter (2014)	24.2%	23.57%	43.70%	44.53%
	Our sample	27.0%	25.63%	46.32%	47.42%
Price revision down	Ritter (2014)	27.0%	29.20%	18.09%	17.02%
	Our sample	29.0%	31.63%	19.40%	18.28%
Underpricing	Ritter (2014)	14.3%	17.03%	64.68%	75.00%
	Our Sample	15.5%	17.91%	66.08%	80.00%
Panel B (only in our IPO sample)					
Sales growth		56%	68%	91%	94%
Firms size		164.1	233.6	254.6	248.5
Offer size (US$ mi)		58.8	95.35	116.1	113.2
Offer-to-firm size		1	1.09	1.12	1.10
Top underwriting		68%	67%	84%	82%
Big-four auditor		33%	31%	36%	34%
Acquisition pre-IPO		33%	33%	25%	26%

Table 4
Descriptive Statistics for Macroeconomic Variables

	Bubble restricted Period (1999-Mar/2000)					Bubble extended period (1999-2000)				
	Mean	**Median**	**Std. Dev.**	**Min**	**Max**	**Mean**	**Median**	**Std. Dev.**	**Min**	**Max**
Δ NASDAQ	2.17%	2.91%	8.95%	-33.08%	20.45%	0.37%	0.84%	9.25%	-33.08%	20.45%
Δ NYSE	0.45%	0.07%	3.82%	-8.05%	9.81%	0.25%	0.02%	3.62%	-8.05%	9.81%
# IPOs	7.15	6.00	4.13	1	18	7.12	6.00	4.73	1	24
Weighted mean of sale growth	6.73%	5.91%	4.29%	0.47%	20.24%	6.53%	5.50%	4.54%	0.47%	20.24%
Weighted mean of actual underpricing	25.72%	23.48%	19.34%	-21.56%	49.65%	23.44%	21.05%	15.32%	-20.38%	45.46%
Weighted mean predicted underpricing	9.59%	6.69%	8.40%	-2.18%	41.69%	8.78%	6.53%	8.80%	-21.84%	41.69%
Weighted mean residual Underpricing 1	14.28%	11.05%	27.30%	-43.18%	70.51%	13.44%	10.22%	25.33%	-42.15%	65.35%
Weighted mean residual Underpricing 2	8.42%	5.46%	25.20%	-36.40%	57.35%	7.48%	4.78%	23.41%	-35.54%	55.38%
Observations	75 weeks					107 weeks				

	Pre Bubble Period (1991-1996)					Transition Period (1997-1998)				
Δ NASDAQ	0.10%	0.13%	0.33%	-0.74%	1.55%	0.17%	0.25%	0.47%	-0.84%	1.09%
Δ NYSE	0.07%	0.07%	0.20%	-0.50%	0.85%	0.13%	0.20%	0.35%	-0.85%	0.86%
# IPOs	5.91	5.00	3.81	1	23	5.38	5.00	3.24	1	16
Weighted mean of sale growth	3.33%	2.76%	2.58%	-0.06%	15.08%	3.59%	3.33%	2.44%	0.01%	11.90%
Weighted mean of actual underpricing	12.20%	11.98%	3.89%	-2.34%	19.82%	13.45%	12.80%	2.87%	-0.52%	20.39%
Weighted mean predicted underpricing	3.13%	2.30%	3.00%	-0.27%	16.14%	3.28%	2.32%	2.76%	0.00%	12.56%
Weighted mean residual Underpricing 1	6.54%	5.58%	18.53%	-23.12%	38.42%	4.33%	3.24%	15.48%	-28.87%	40.32%
Weighted mean residual Underpricing 2	4.85%	3.92%	15.37%	-18.53%	32.26%	3.95%	3.18%	18.45%	-26.25%	37.52%
Observations	282 weeks					105 weeks				

Table 5
Correlation Matrix for Macroeconomic Variables

		Δ NASDAQ	Δ NYSE	Number of IPOs	Mean sale	Mean actual	Mean predicted	Mean residual 1
Δ NYSE	Pre-bubble	**0.76*** **						
	Transition	**0.80*** **						
	Bubble 1	**0.47*** **						
	Bubble 2	**0.43*** **						
Number of IPOs	Pre-bubble	-0.03	0.05					
	Transition	-0.38	-0.17					
	Bubble 1	-0.07	-0.01					
	Bubble 2	0.03	-0.11					
Mean sale growth	Pre-bubble	-0.05	0.04	**0.90*** **				
	Transition	-0.21	-0.06	**0.34*** **				
	Bubble 1	-0.04	0.09	**0.94*** **				
	Bubble 2	-0.1	-0.07	**0.94*** **				
Mean actual underpricing	Pre-bubble	-0.04	0.01	0.04	0.09			
	Transition	-0.18	-0.13	0.06	0.12			
	Bubble 1	0.15	0.12	0.16	0.19			
	Bubble 2	0.13	0.18	0.09	0.15			
Mean predicted underpricing	Pre-bubble	**0.18*** **	0.18	**0.73*** **	**0.67*** **	**0.95*** **		
	Transition	**0.13***	0.17	**0.59*** **	**0.54*** **	**0.33*** **		
	Bubble 1	**0.07***	0.18	**0.73*** **	**0.75*** **	**0.30*** **		
	Bubble 2	**0.15***	0.10	**0.78*** **	**0.78*** **	**0.20** **		
Mean residual 1	Pre-bubble	-0.03	0.02	0.15	0.16	**0.36*** **	0.12	
	Transition	0.04	-0.21	-0.05	0.12	**0.30*** **	0.14	
	Bubble 1	0.02	-0.10	-0.04	-0.03	**0.65*** **	0.06	
	Bubble 2	0.08	-0.06	-0.03	-0.10	**0.63*** **	0.12	
Mean residual 2	Pre-bubble	-0.06	-0.02	0.03	0.04	**0.25*** **	**0.26*** **	**0.71*** **
	Transition	0.05	-0.16	-0.14	0.12	**0.34*** **	**0.25*** **	**0.84*** **
	Bubble 1	0.06	-0.08	0.03	0.05	**0.70*** **	**0.23*** **	**0.82*** **
	Bubble 2	0.08	-0.12	0.15	0.18	**0.75*** **	**0.28*** **	**0.85*** **

Graph 1
NASDAQ and NYSE Composite Indices
(weekly)

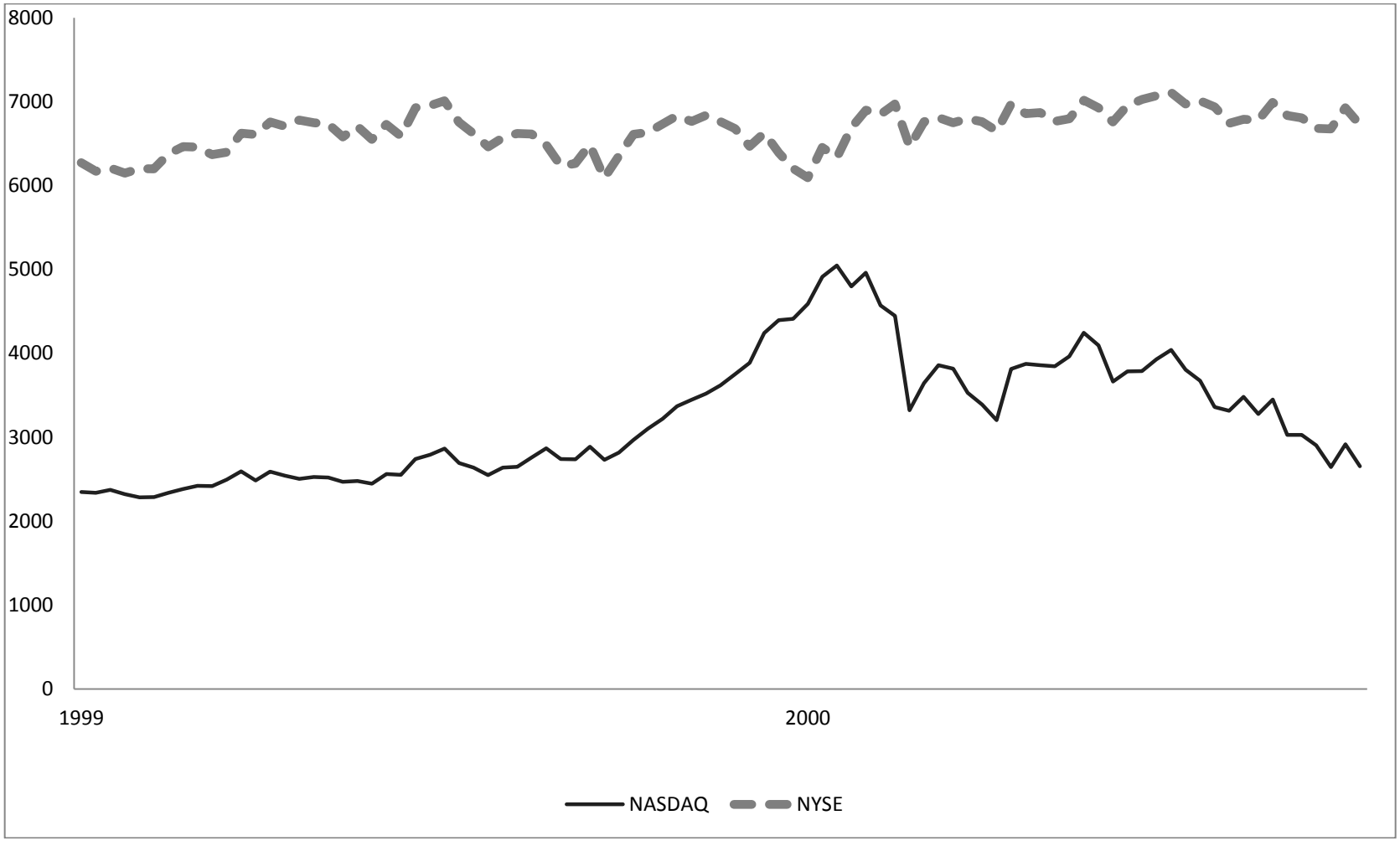

Table 6
The Price Spiral in the Bubble Period
(Panel A)

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 in parentheses. We use *, ** and *** to denote statistical significance at the 10, 5 and 1 percent levels (two sided).

	Δ NASDAQ in 3 Weeks						**Δ NASDAQ in 1Week**					
	Bubble Restricted (1999-March/2000)											
	Proxies for expected growth rate						**Proxies for expected growth rate**					
regression	**1A**	**1B**	**1C**	**1D**	**1E**	**1F**	**2A**	**2B**	**2C**	**2D**	**2E**	**2F**
	None	**Actual underp.**	**Predicted underp.**	**Sales growth**	**Residual underp. 1**	**Residual underp. 2**	**None**	**Actual underp.**	**Predicted underp.**	**Sales growth**	**Residual underp. 1**	**Residual underp. 2**
Δ NYSE	**0.948***	**1.095*****	**0.833***	**0.935***	**1.105*****	**1.103*****	**1.222*****	**1.030*****	**1.141*****	**1.206*****	**1.039*****	**1.043*****
	(1.77)	**(6.56)**	**(1.71)**	**(1.72)**	**(6.14)**	**(6.24)**	**(3.68)**	**(8.05)**	**(3.24)**	**(3.55)**	**(8.22)**	**(7.97)**
# IPOs	0.001	**-0.003*****	**-0.010***	**-0.007***	0.001	0.001	0.000	**-0.001*****	-0.004	**-0.002***	0.001	0.001
	(0.50)	**(-4.11)**	**(-1.66)**	**(-1.95)**	(1.47)	(1.41)	(0.13)	**(-3.40)**	(-1.54)	**(-1.93)**	(1.37)	(1.12)
Proxy for growth		**0.005*****	**0.008****	**0.001***	**0.001*****	**0.011****		**0.003*****	**0.003****	**0.001****	**0.001*****	**0.018****
		(5.00)	**(2.13)**	**(1.86)**	**(4.32)**	**(2.14)**		**(4.13)**	**(2.33)**	**(2.07)**	**(2.63)**	**(2.47)**
R-Squared	0.21	0.40	0.32	0.45	0.45	0.54	0.19	0.45	0.31	0.42	0.42	0.51
	Bubble Extended (1999-2000)											
	Proxy for expected growth rate						**Proxy for expected growth rate**					
regression	**3A**	**3B**	**3C**	**3D**	**3E**	**3F**	**4A**	**4B**	**4C**	**4D**	**4E**	**4F**
	None	**Actual underp.**	**Predicted underp.**	**Sales growth**	**Residual underp. 1**	**Residual underp. 2**	**None**	**Actual underp.**	**Predicted underp.**	**Sales growth**	**Residual underp. 1**	**Residual underp. 2**
Δ NYSE	**0.922***	**0.833***	**0.613***	0.732	**0.819***	**0.843***	**1.201*****	**1.141*****	**0.746****	**0.857****	**1.199*****	**1.193*****
	(1.67)	**(1.71)**	**(1.74)**	(1.48)	**(1.72)**	**(1.80)**	**(3.44)**	**(3.24)**	**(2.01)**	**(2.45)**	**(3.26)**	**(3.33)**
# IPOs	0.000	**-0.010***	-0.002	**-0.005****	-0.001	0.000	-0.000	-0.004	-0.002	0.000	0.000	0.000
	(0.08)	**(-1.66)**	(-0.72)	**(-2.33)**	(-0.24)	(0.03)	(-0.23)	(-1.54)	(-0.63)	(0.17)	(0.22)	(0.12)
Proxy for growth		**0.008****	**0.005****	**0.002*****	**0.001*****	**0.011***		**0.003****	0.003	**0.001***	-0.000	0.003
		(2.13)	**(2.27)**	**(4.67)**	**(2.80)**	**(1.73)**		**(2.33)**	(1.54)	**(1.78)**	(-0.13)	(0.15)
R-Squared	0.09	0.19	0.15	0.17	023	0.21	0.08	0.19	0.14	0.16	0.22	0.23

Table 6
The Price Spiral out of the Bubble Period
(Panel B)

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 in parentheses. We use *, ** and *** to denote statistical significance at the 10, 5 and 1 percent levels (two sided).

	Δ NASDAQ in 3 Weeks						**Δ NASDAQ in 1Week**					
	Pre-Bubble Period (1991-1996)											
	Proxies for expected growth rate						**Proxies for expected growth rate**					
regression	**5A**	**5B**	**5C**	**5D**	**5E**	**5F**	**6A**	**6B**	**6C**	**6D**	**6E**	**6F**
	None	**Actual**	**Predicted**	**Sales growth**	**Residual underp. 1**	**Residual underp. 2**	**None**	**Actual**	**Predicted**	**Sales growth**	**Residual underp. 1**	**Residual underp. 2**
Δ NYSE	**1.460*** (10.21)**	**1.303*** (14.78)**	**1.303*** (14.78)**	**1.461*** (10.41)**	**1.420*** (16.38)**	**1.414*** (16.48)**	**1.222*** (3.68)**	**1.030*** (8.05)**	**1.141*** (3.24)**	**1.461*** (10.41)**	**1.253*** (15.29)**	**1.256*** (17.58)**
# IPOs	-0.000 (-0.42)	**-0.004*** (-4.40)**	**-0.004*** (-4.40)**	0.001 (1.05)	-0.000 (-0.44)	-0.000 (-0.37)	0.000 (0.13)	**-0.001*** (-3.40)**	-0.004 (-1.54)	0.001 (1.05)	-0.000 (-0.46)	-0.000 (-0.02)
Proxy for growth		**0.007*** (4.71)**	**0.007*** (4.71)**	-0.001 (-1.64)	-0.004 (-0.82)	-0.009 (-1.31)		**0.003*** (4.13)**	**0.003** (2.33)**	-0.001 (-1.64)	-0.019 (-1.62)	-0.007 (-0.41)
R-Squared	0.27	0.63	0.44	0.48	0.64	0.63	0.19	0.45	0.31	0.48	0.64	0.63
	Transition Period (1997-1999)											
	Proxy for expected growth rate						**Proxy for expected growth rate**					
regression	**7A**	**7B**	**7C**	**7D**	**7E**	**7F**	**8A**	**8B**	**8C**	**8D**	**8E**	**8F**
	None	**Actual**	**Predicted**	**Sales growth**	**Residual underp. 1**	**Residual underp. 2**	**None**	**Actual**	**Predicted**	**Sales growth**	**Residual underp. 1**	**Residual underp. 2**
Δ NYSE	**1.260*** (19.54)**	**1.214*** (19.97)**	**1.214*** (19.97)**	**1.297*** (17.18)**	**1.265*** (26.67)**	**1.120*** (26.86)**	**1.262*** (15.12)**	**1.086*** (23.11)**	**1.086*** (23.11)**	**1.273*** (14.64)**	**1.115*** (24.19)**	**1.115*** (24.19)**
# IPOs	-0.001 (-0.71)	**-0.004** (-2.17)**	**-0.004** (-2.17)**	**-0.003 (-1.03)**	-0.001 (-0.92)	-0.000 (-0.42)	-0.001 (-0.89)	**-0.002** (-2.40)**	**-0.002** (-2.40)**	-0.001 (-1.22)	-0.000 (-0.51)	-0.000 (-0.51)
Proxy for growth		**0.005** (2.41)**	**0.005** (2.41)**	0.000 (0.87)	0.007 (0.55)	0.010 (1.49)		**0.003*** (2.65)**	**0.003*** (2.65)**	0.001 (0.91)	0.014 (0.89)	0.014 (0.89)
R-Squared	0.41	0.74	0.65	0.62	0.76	.075	0.38	0.73	0.62	0.60	0.74	0.73