DO INVESTORS LEAVE MONEY ON THE TABLE?
IPO SECONDARY MARKET RETURNS AND VOLATILITY

Daniel J. Bradley[†]
Clemson University

John S. Gonas[††]
Belmont University

Michael J. Highfield[†††]
Mississippi State University

February 20, 2006

JEL Classification: G12; G14; G24

Keywords: IPO; Underpricing; Partial Adjustment; Nasdaq SR-NASD-98-98; Laddering

---

[†] Daniel J. Bradley, CFA, Clemson University. Address: Department of Finance, 324B Sirrine Hall, College of Business and Behavioral Science, Clemson University, Clemson, South Carolina, 29634. Office Phone: 864.656.6545. Electronic Mail: dbradle@clemson.edu.
[††] John S. Gonas, Belmont University. Address: School of Business, 1900 Belmont Boulevard, Nashville, Tennessee 37212. Office Phone: 615.460.6907. Office Fax: 615.460.6487. Electronic Mail: gonasj@belmont.edu.
[†††] Michael J. Highfield, CFA, Mississippi State University. Address: Department of Finance and Economics, College of Business and Industry, Mississippi State University, Post Office Box 9580, Mississippi State, Mississippi, 39762-9580. Office Phone: 662.325.1984. Office Fax: 662.325.1977. Electronic Mail: m.highfield@msstate.edu.

The authors are grateful to Jack Cooney, Jacqueline Garner, Brad Jordan, Jay Ritter, and seminar participants at Louisiana Tech University, Mississippi State University, the University of Kentucky, and the 2005 Financial Management Association Annual Meeting for helpful comments and suggestions. All errors remain ours.

DO INVESTORS LEAVE MONEY ON THE TABLE?
IPO SECONDARY MARKET RETURNS AND VOLATILITY

Abstract

IPO stock prices increased approximately four percent on the first day of secondary market trading over the period 1997 to mid-2004. While these aftermarket returns are accentuated during 1999 and 2000, they persist after the bubble burst. We find this open-to-close return is strongly related to adjustments in the offer price relative to the original file range, and we also find venture capital backing is related to this intraday return, but not the offer-to-open return. Finally, a regulatory change designed to reduce Nasdaq IPO volatility on the first day of trading possibly had the undesired effect of increasing it.

JEL Classification: G12; G14; G24

Keywords: IPO; Underpricing; Partial Adjustment; Nasdaq SR-NASD-98-98; Laddering

DO INVESTORS LEAVE MONEY ON THE TABLE?
IPO SECONDARY MARKET RETURNS AND VOLATILITY

Documentation of the large initial returns accruing to those receiving IPO allocations at the offer price is ubiquitous in the finance literature. For example, Loughran and Ritter (2004) examine 6,391 IPOs issued during the period 1980–2003 and find that the mean first-day return is 18.7 percent. Moreover, during the bubble period of 1999–2000 they find that the mean first-day return is 65.0 percent. In their study, like most others, this initial return, typically referred to as underpricing, is defined as the percentage difference between the offer price and closing price on the first day of trading.[1]

While many explanations have been offered as to why underpricing exists, one of the most widely accepted is the partial adjustment model of Benveniste and Spindt (1989). In their model, investment banks gauge demand for the IPO by gathering information from their clients; however, these investors must be compensated in order to reveal their true demand for the issue. To do so, the underwriter sets the offer price at a discount relative to the expected equilibrium price. In theory, this underpricing is reflected in the first transaction once secondary market trading commences. Thus, only the suppliers of information who are allocated shares of the IPO are rewarded.

Generally speaking, it is extremely difficult for the average investor to receive an IPO allocation, especially for "hot" IPOs. Thus, if the entire initial return is credited to primary investors, as the Benveniste and Spindt (1989) model assumes, it is not profitable for an investor to participate in the IPO market unless she can receive an allocation at the offer price. However, anecdotal evidence presented in the popular press, particularly during the internet bubble period,

highlights abnormally high secondary market returns and trading volume for IPOs on the first day of trading, and even suggests the potential for profit after the initial trade.[2] Moreover, in response to concerns about increased order flow and volatility of IPOs, the Nasdaq introduced a regulatory change in January 1999 designed to allow market makers more time to evaluate the aftermarket demand for IPOs. In theory, the extra time would allow market makers to post quotes closer to the equilibrium price level, thereby reducing volatility on the first day of trading. Despite the practical emphasis placed on intraday IPO returns, the theoretical implications it may have, and the regulatory interest in the issue, there is relatively little evidence investigating first-day market behavior for IPOs.

We examine secondary market returns and volatility for a sample of 1,320 IPOs placed in U.S. markets from January 1, 1997 to June 30, 2004. We have four main contributions. First, our results show that the average IPO gained four percent from open to close on the first day of trading. The average is slightly higher for Nasdaq IPOs and is driven upwards by IPOs that went public during the bubble period, but first-day aftermarket returns from 2001–2004 for Nasdaq stocks remained an economically large three percent. In fact, the open-to-close return during the post-bubble period represents approximately one-fifth of total underpricing, which is more than double the proportion observed during the bubble period. Thus, our evidence indicates that first-day secondary market returns for IPOs are much larger than previously thought, and perhaps exploitable even with typical market friction assumptions.

Second, we find a strong, positive relation between aftermarket returns and adjustments in the offer price relative to the original file range. The Benveniste and Spindt (1989) private

---

[1] See also Logue (1973), Ibbotson (1975), Ibbotson and Jaffe (1975), Ritter (1984), Miller and Reilly (1987), Ibbotson, Sindelar, and Ritter (1988), and Loughran and Ritter (2002).

[2] For example, see Hegde and Miller (1989) and "A call to overhaul the IPO process", Raymond Hennessey, *Wall Street Journal*, November 12, 2002.

information model suggests that only the suppliers of information are compensated with underpricing, but our results indicate that the benefits of underpricing accrue to secondary market participants as well. For instance, a strategy of buying at the open and selling at the close every Nasdaq IPO priced above the file range would yield a raw one-day return of 7.1 percent. In the post-bubble years we find that this strategy would yield 6.3 percent.

Third, several papers have acknowledged that venture capital backing is positively related to underpricing; however, we find that this venture capital effect is impounded in open-to-close returns, not offer-to-open returns. While this finding has not previously been documented in the IPO literature and has important implications from an academic perspective, it also has important implications for investors who wish to trade IPOs in the aftermarket.

Finally, a Nasdaq regulation was implemented in 1999 as a means to reduce uncertainty on the first day of secondary market trading, but our evidence suggests that SR-NASD-98-98 may have actually accentuated volatility. Examining the effect of the Nasdaq regulation is complicated by the fact that it coincided with the internet bubble period. Thus, it is difficult to determine if the increased volatility was a result of the regulation or the types of firms going public; however, after eliminating the 1999–2000 period we find that first-day volatility is significantly greater post-regulation (2001–2004) than pre-regulation (1997–1998) after controlling for issue and issuer characteristics.

The remainder of the paper is organized as follows. Section I summarizes the underpricing literature and describes the Nasdaq regulation designed to reduce aftermarket volatility. Section II describes the data. Section III provides empirical results for IPO returns while Section IV examines the effect of regulation SR-NASD-98-98. Section V concludes the paper.

I. Previous literature and Nasdaq SR-NASD-98-98

A. Previous work

As indicated earlier, the existing IPO literature almost exclusively defines underpricing as the percentage difference between the closing price and offer price on the first day of trading. There are a few exceptions. Barry and Jennings (1993) investigate open-to-close returns for IPOs. They find that almost all of the first-day's return is reflected in the opening transaction, suggesting that IPO subscribers, who are allocated shares at the offer price, are the sole beneficiaries of underpricing. While this result is fully consistent with the Benveniste and Spindt (1989) model where the suppliers of information receive the benefits of underpricing, this hypothesis was not tested in their paper. Moreover, their December 1988 to December 1990 sample only contains 229 observations.

Aggrawal and Conroy (2000) focus on the price discovery process of IPOs during the pre-opening window.[3] While Barry and Jennings (1993) focus on the open-to-close return, Aggrawal and Conroy investigate the offer-to-open return. Using propriety data, they find that the first quote entered by the lead underwriter in the pre-opening period explains a large percentage of the initial return. Thus, the lead underwriter has a relatively good idea of what the equilibrium price should be based on the information they possess.[4]

---

[3] There is a pre-opening window just before trading begins in an IPO. In Aggrawal and Conroy's (2000) study, this period can be a maximum of five minutes and a minimum of zero seconds. The lead underwriter informs Nasdaq when it wants to begin trading the IPO. During this period, the lead underwriter enters the first quote and other market makers typically follow suit. These quotes are not binding as market makers can add, cancel, or revise their quotes before trading actually begins.

[4] In an auxiliary result, Aggrawal and Conroy (2000) report that the mean offer-to-close return is 19.47 percent and the mean offer-to-open return is 17.66 percent. Hence, the implied open-to-close return is very small, consistent with findings in Barry and Jennings (1993). In a small sample of 72 IPOs from March 31, 1992 to June 1, 1992, Schultz and Zaman (1994) find an average 3 percent open-to-close return.

More recently, Hao (2005) documents large and presumably exploitable first-day open-to-close returns during the 1999-2000 period and provides a potential explanation for her results based on "laddering." Also known as "tie-in" arrangements, laddering is a term used to describe the underwriting practice of allocating IPO shares at the offer price with the implicit agreement that additional shares will be purchased in the aftermarket. By forcing investors to buy shares in the aftermarket as a necessary condition to receive IPO allocations, this could lead to higher intraday returns. As noted by Hao (2005), hundreds of IPO laddering lawsuits were filed against underwriters in 2001 alone.[5] The allegations suggest that laddering is a form of market manipulation and illegal under the Securities Act of 1933 and the Securities Exchange Act of 1934.[6]

B. Nasdaq SR-NASD-98-98

In response to the growth in stock price volatility and underpricing on the first day of an IPO's trading, the Nasdaq requested that the Securities and Exchange Commission approve SR-NASD-98-98 on January 22, 1999.[7] This new regulation became effective on January 26, 1999, and was implemented to stabilize trading activity and extreme price fluctuations, triggering locked and crossed quotes as well as investor dissatisfaction in the timing and pricing of initial secondary market transactions. To alleviate such problems, the regulation extended the pre-opening window from a five-minute maximum to a mandatory 15 minutes. If the bid and ask quotes were locked or crossed at the end of the 15 minutes, the regulation allowed for an

[5] For example, Goldman Sachs, Morgan Stanley, J.P. Morgan, Credit Suisse First Boston and others have settled with the SEC on charges of laddering.
[6] In particular, Sections 11, 12(a)(2), and 15 of the Securities Act of 1933 and Section 10(b) (Rule 10b-5) of the Securities Exchange Act of 1934. For a very detailed explanation of laddering and securities law pertaining to it, see Deneen and Hoghuis (2001).
[7] See Securities Exchange Act Release No. 34-40968 (January 22, 1999), 64 FR 4729 (January 29, 1999).

additional 15-minute window. At the end of the second window the stock would open for trading regardless of extreme divergences in market maker quotes, and the market would simply dictate the price. In theory, this rule was designed to allow market participants to be better informed and hopefully permit an IPO to reach its equilibrium price level more quickly than what was observed under the shorter pre-opening window platform.

According to a 1999 NASD press release, the extended 15-minute time period was implemented as a response to a significant increase in volatility during the opening of trading in IPOs on the Nasdaq.[8] Officials at the Nasdaq believed that an increase in the length of the pre-trading quotation window would give market participants time to more accurately gauge and respond to IPO market price indications before the start of trading. However, the 15-minute pre-opening time period still only served as a window/warning of the opening, similar to the opening of an OTC stock in the morning at 9:30. In other words, there is no price set by Nasdaq; each market maker sets his bid/offer in their quote line (seen on level 2 Nasdaq systems) within the window and then the stock becomes "live" with the aggregation of quotes and the Nasdaq system pairing market and limit orders.[9]

II. Data and descriptive statistics

We collect a sample of IPOs using the Thomson Financial Securities Data Company (SDC) U.S. New Issues Database for the period January 1, 1997 through June 30, 2004. Consistent with previous research, we eliminate depository shares, spin-offs, real estate investment trusts (REITs), reverse leveraged buyouts, unit offers, banks, savings and loans,

[8] See Nasdaq Head Trader Alert: 1999–1 http://www.nasdaqtrader.com/Trader/1999/headtraderalerts/hta1999-1.stm. The rule was reinforced in HTA 1999-69: http://www.nasdaqtrader.com/Trader/1999/headtraderalerts/hta1999-69.stm.
[9] On October 24, 2004, officials at Nasdaq eliminated the conditional second 15-minute window. See Head Trader Alert#2004-130: http://www.nasdaqtrader.com/Trader/News/2004/headtraderalerts/hta2004-130.stm.

closed-end funds, IPOs with offer prices less than five dollars, and firms not listed in the Center for Research in Security Prices (CRSP) database. In addition to issuer characteristics obtained from the SDC database, we obtain Carter-Manaster (1990) underwriter reputation ratings from Loughran and Ritter (2004).[10] Offering, opening, and closing stock prices are collected from Hoover's IPO Central and *The IPO Reporter*.[11] IPO daily high prices, daily low prices, and daily returns are collected from CRSP. Our sample consists of 1,320 observations for which we have full information meeting the criteria described above.

*** Table 1 About Here ***

Table 1 gives the descriptive statistics of our sample. As shown, the average offer size (*Offer Size*) is approximately $107 million and the mean offer price (*Offer Price*) is $14.03. Roughly 88 percent of our sample consists of issues with integer offer prices (*Integer*) and about 54 percent receive venture capital (*Venture Capital*) financing. Since approximately 84 percent of our IPOs are Nasdaq-listed (*Nasdaq*), it is not surprising that more than half of the sample (67 percent) is classified as high-tech (*Tech*). These averages are consistent with other studies that have overlapping sample periods.

Other conditioning variables that previously shown to influence underpricing are also presented. Bradley and Jordan (2002) show that *Overhang*, shares retained by insiders scaled by the number of shares offered, is positively related to underpricing. Our average of 3.6 is consistent with their study. Extending from the partial adjustment model of Benveniste and Spindt (1989) and the empirical results of Hanley (1993), we find that the average IPO during our sample period has an offer price 7.1 percent greater than the midpoint of the original file

[10] This information is available at Jay Ritter's website (bear.cba.ufl.edu/ritter).

[11] To ensure the quality of our data, for several random observations we cross-referenced data obtained from Hoover's IPO Central with data published in *The IPO Reporter*.

range (*Partial*). We find that the average Carter-Manaster (*Reputation*) ranking of a lead underwriter for the year of the IPO is 7.8 on a 9-point scale. Finally, *Market Lag* shows that the average cumulative return of the Nasdaq composite for the fifteen days prior to the IPO date is 1.1 percent. In general, our sample statistics are homogenous with previous studies using the same variables.

The remaining variables in Table 1 are the primary focus of this study. The average IPO in the sample is underpriced (*Total Underpricing*) by 43.6 percent. This high initial return is comparable to other studies investigating first-day returns during this period, and is primarily driven upwards by internet firms during 1999 and 2000. Similar to Barry and Jennings (1993), we dissect this initial return into two parts, o*ffer-to-open,* the percentage return between the offering price and the opening market price on the first day of secondary market trading, and o*pen-to-close*, the percentage return between the opening market price and the closing price on the first day of secondary market trading. For our sample, the offer-to-open return averages 38.2 percent and represents 87.7 percent of the total underpricing. Hence, consistent with Barry and Jennings, our evidence suggests that primary investors are the main beneficiaries of IPO underpricing. On the other hand, the open-to-close return shows that the average IPO increases in value by approximately 3.9 percent in secondary market trading.[12] While Barry and Jennings report an average open-to-close return of 60 basis points and argue that such a return would not overcome transaction costs, the average secondary market return we document is much larger.[13]

[12] Note that total underpricing is not simply the sum of the offer-to-open return and the open-to-close return. For example, suppose an IPO has an offer price of $10, opens at $11, and closes at $12. The offer-to-open return is 10 percent, the open-to-close return is 9.1 percent, but total underpricing is 20 percent.

[13] Barry and Jennings (1993) also report an average open-to-close return of 87 basis points for firms that survived through their entire sample period. Again, the return is not economically significant in light of typical transaction costs.

Using the same method as Barry and Jennings (1993), we estimate the standard deviation of the intraday returns (*Volatility*). Given the assumption that the logarithm of stock prices follows a random walk, Parkinson (1980) shows that the standard deviation of stock prices can be estimated using the natural logarithm of the ratio of the high and low prices for the day.[14] We observe an average standard deviation estimate of 19.49 percent on the first day of secondary market trading. Finally, 72 percent of the sample went public after the implementation of Nasdaq SR-NASD-98-98.

III. Empirical results for IPO returns

Our descriptive statistics in Table 1 are consistent with previous studies that document the majority of underpricing is impounded in the first trade; however, unlike the 1988–1990 time period studied by Barry and Jennings (1993), our preliminary indications show potential secondary aftermarket rewards exist. To begin our analysis, we examine univariate sorts to further evaluate the data.

A. Univariate Sorts

We first investigate underpricing by exchange and time period for three reasons. First, most high technology firms tend to list on the Nasdaq market. Second, the regulation pertaining to aftermarket volatility relates exclusively to Nasdaq-listed IPOs. Finally, it is customary to analyze the internet bubble separately from other periods, particularly for IPOs. In this initial analysis, we partition our data into four groups: (1) the full sample of IPOs; (2) IPOs issued prior

[14] This method was first used by Parkinson (1977) in pricing put options and later formalized in Parkinson (1980). Wiggins (1991) shows that the efficiency of Parkinson's extreme value estimator of standard deviation significantly exceeds that of the close-to-close estimators for most price and volume groups.

to the internet bubble period (1997–1998); (3) IPOs issued during the internet bubble period (1999–2000); and (4) IPOs issued after the internet bubble period (2001–2004).

*** Table 2 About Here ***

The first line in Table 2 repeats the mean underpricing values shown in Table 1. The next two lines provide returns for NYSE/AMEX- and Nasdaq-listed IPOs. The corresponding *p*-value tests for differences between these two groups. As shown, total underpricing for Nasdaq issues is significantly higher than NYSE/AMEX issues. In the remaining analyses, we provide total underpricing for the reader's interest, but we refrain from comment since our focus is on the other measures. For the full sample, the offer-to-open return for NYSE/AMEX firms is 11.7 percent compared to 43.1 percent for Nasdaq-listed IPOs. The difference between the exchanges is economically large and statistically significant at any conventional level. The average open-to-close return over the full sample for NYSE/AMEX firms is 1 percent compared to 4.5 percent for Nasdaq IPOs. Again, this difference is large and statistically significant.

We next compare the time periods focusing on the differences in exchanges. The offer-to-open return is significantly different between the exchanges during the 1997–1998 and the 1999–2000 period, but not the post-bubble period of 2001–2004. Of more interest, however, is the open-to-close return. In all periods, Nasdaq open-to-close returns exceed 2 percent and are significantly different than NYSE/AMEX listed IPOs. During the bubble period, aftermarket returns reached almost 6 percent for Nasdaq IPOs; however, they averaged about 3 percent in the post-bubble period despite the fact that total underpricing was only about 13 percent. Thus, while aftermarket returns decreased in the post-bubble period, they increased significantly as a percentage of total underpricing. For instance, during the bubble period, this percentage was 8.3

percent (5.92/71.10). The corresponding number for the post-bubble period was 22.9 percent (2.94/12.86).

The analysis in Table 2 provides three interesting insights. First, secondary market returns are significantly different for Nasdaq IPOs as compared to NYSE/AMEX IPOs. Second, open-to-close returns are much larger than previously documented and perhaps exploitable for Nasdaq-listed IPOs. Finally, during the post-bubble period, secondary market participants enjoyed approximately one-fourth of the total underpricing.

In Table 3, we provide results based on where the issue is priced relative to the original file range. According to the dynamic information acquisition model of Benveniste and Spindt (1989), investment banks must compensate primary market investors for truthfully revealing their demand for a new issue. They do so by partially adjusting the offer price upwards, but not to the full equilibrium level. The result is underpricing, which benefits those allocated shares at the offer price. Consistent with this view, Hanley (1993) and others have found that upward adjustments in the offer price are positively associated with greater underpricing. However, we are aware of no study that merges first-day aftermarket returns and partial adjustment effects.

We emphasize that the partial adjustment model assumes that only the suppliers of information allocated shares at the offer price benefit from underpricing. Thus, the model suggests a positive relation between upward adjustments in the offer price and the offer-to-open return, but not the open-to-close return. Under the Benveniste and Spindt (1989) model, any adjustment should be fully incorporated in the first trade. Aggrawal and Conroy (2000) support this view in that the lead underwriter has sufficient information to set the market price.

*** Table 3 About Here ***

As in Table 2, we provide three measures of returns (offer-to-open, open-to-close, and total underpricing) and dissect the sample by time period. Consistent with the partial adjustment model, IPOs priced above the file range have the highest offer-to-open return (86.7 percent), followed by those priced within the file range (15.5 percent), and finally those below the file range (7.2 percent). Although this pattern is most evident during the bubble period, it generally holds over the entire sample period. That is, firms that are priced above the file range are the most underpriced. Only during the pre-bubble period are issues priced within the file range roughly the same as those priced below the range.

Of more interest, and what previous studies fail to investigate, is the relation between the partial adjustment effect and secondary market returns. For the full sample, IPOs priced above the file range experience a 6.6 percent aftermarket return. Issues priced within and below the file range exhibit 3.1 percent and 1.3 percent returns, respectively. Thus, open-to-close returns exhibit behavior similar to that observed for offer-to-open returns.

With the exception of 1997 and 1998, open-to-close returns are significantly larger for deals priced above the file range than those priced within or below the file range. Although the average open-to-close return for the full sample is driven upwards by the bubble period, the 5.4 percent average during the post-bubble period remains economically large.

In Panel B of Table 3, we exclude AMEX/NYSE IPOs. As expected, open-to-close returns become marginally larger when these deals are excluded. For example, in Panel A, the open-to-close return for the full sample priced above the file range is 6.6 percent. The corresponding number for Nasdaq-only IPOs is 7.1 percent.

Overall, the results in Table 3 highlight several important findings. First, it appears that prices partially adjust from the offer-to-open, but then again from the open-to-close. The

Benveniste and Spindt (1989) model of underpricing predicts the first adjustment, but not the second. Thus, secondary market investors are also being rewarded despite the fact they are not providing private information.

B. Multivariate Regression Analysis

To sort out various joint effects, we employ standard multivariate regression analyses. We rely on the vast underpricing literature to establish our model, but we exclusively adjust our analysis to define underpricing as a function of three return sets: offer-to-close, offer-to-open, open-to-close. For example, several studies show that venture capital is related to initial returns; however, does VC-backing influence where the lead underwriter opens the IPO or is it related to secondary market trading? In other words, some of the effects documented in the underpricing literature may be related to one or both of these returns. We examine this issue using the following model:

$$\begin{aligned} Return_i = {} & \beta_0 + \beta_1 Integer_i + \beta_2 Venture\ Capital_i + \beta_3 Overhang_i + \beta_4 Tech_i + \beta_5 Partial_i \\ & + \beta_6 Reputation_i + \beta_7 Log\ Size_i + \beta_8 Nasdaq_i + \beta_9 Market\ Lag_i + \varepsilon_i, \end{aligned} \quad (1)$$

where *Return* represents one of three dependent variables: *Total Underpricing, Offer-to-Open*, and *Open-to-Close*. *Total Underpricing* is the percentage change from the offer price to the last trade/closing price on the first day of trading. *Offer-to-Open* is the percentage change from the IPO offer price to the first trade/open price on the first day of trading. *Open-to-Close* is the percentage change from the first trade/open price on the first day of trading to the last trade/closing price on the first day of trading.

Integer is a binary variable equal to one if the offer price is an integer, zero otherwise. Bradley, Cooney, Jordan, and Singh (2004) find that offerings priced on the integer are more

underpriced than those priced on the fraction. *Venture Capital* is a binary variable equal to one if the issuing firm is venture-capital backed, zero otherwise. Mixed results have been found based on the relation between venture-capital backing and underpricing. Megginson and Weiss (1991) find an inverse relation between underpricing and venture capital, but Lee and Wahal (2004) and Loughran and Ritter (2004) find a positive relation. *Overhang* is the number of shares retained by insiders divided by the number of shares offered in the IPO. Bradley and Jordan (2002) find that overhang is positively related to underpricing. *Tech* is a binary variable equal to one if the issuing firm's business is in a high-tech industry, zero otherwise. Following Hanley (1993) and others, *Partial* is the percentage change from the mid-point of the original file range to the offer price. *Reputation* is the Carter-Manaster reputation ranking of the lead underwriter of the IPO. *Log Size* is the natural logarithm of the offer size of the IPO. *Nasdaq* is a binary variable equal to one if the IPO is listed on the Nasdaq exchange, zero otherwise, and *Market Lag* is the cumulative return of the Nasdaq composite for the fifteen days prior to the IPO date.

*** Table 4 About Here ***

Regression results for the full sample are presented in Panel A of Table 4. Similar to previous studies, total underpricing is positively related to venture capital, overhang, high-tech firms, partial adjustment, underwriter reputation, and market momentum. We find very similar results for offer-to-open returns with the exception of venture-capital, which is no longer significant. Comparing the Adjusted R^2 between the total underpricing (48.8 percent) and offer-to-open (46.2 percent) models indicates that, not surprisingly, the majority of underpricing can be explained by the first trade; however, the open-to-close model reveals two interesting findings. First, venture capital is significant at the one-percent level whereas, as previously mentioned, it is not significant for the offer-to-open model. Thus, while many recent studies

document significant underpricing for venture-capital backed IPOs, our evidence indicates that it is primarily a result of secondary market returns. Second, after conditioning for other effects, we find that the open-to-close return is positively related to adjustments in the offer price relative to the file range and highly significant. The coefficient of 0.097 suggests that a 10 percent increase in the offer price with respect to the midpoint of the initial file range will result in approximately a 1 percent increase in the open-to-close return. The partial adjustment model of Benveniste and Spindt (1989) does *not* predict this aftermarket adjustment.

In Panel B of Table 4, we exclude bubble period issues. Again, the results are qualitatively similar between Panels A and B despite the fact that we lose statistical power in Panel B by reducing the sample size by over half. Specifically, venture capital is significant (marginally) under the *Total Underpricing* and *Open-to-Close* regressions, but not for the *Offer-to-Open* model. More importantly, *Partial* remains highly significant in all models considered.

Our results show that secondary market returns for IPOs have increased dramatically over time, and we also find that the open-to-close return is strongly related to the partial adjustment variable. Market stabilization by underwriters is typically associated with weak IPOs, which is most likely those issues priced below or within the file range, but our results indicate that aftermarket returns are highest for the strongest IPOs priced above the file range. Hao (2005) provides a potential explanation for our results based on laddering. Although she does not explicitly consider partial adjustment in her model, issues priced above the file range would be the focus of such "tie-in" arrangements. While her model would predict laddering as an explanation for high secondary market returns during the bubble period, it seems inconsistent with our results post-bubble because the practice was uncovered and explicitly banned in 2001. However, we note an important qualification to this ban. There is a legal difference between

underwriters suggesting that a buyer *must* buy more shares in the aftermarket as a necessary condition to get a favorable allocation, and a buyer *volunteering* to buy more shares in the aftermarket to receive a favorable allocation. Although these are both forms of laddering, only the former quid pro quo agreement is illegal. Thus, the voluntary form of laddering may still be a valid explanation for what we observe post-bubble; however, with the dramatic decline in total underpricing in the later sample years, the incentive to voluntarily ladder does not seem very strong.

IV. Effect of regulation SR-NASD-98-98 on IPO volatility

The final issue we examine is the effect of regulation SR-NASD-98-98 for Nasdaq IPOs. As described in Section I, this regulation extended the pre-opening window to reduce opening day volatility and facilitate the price discovery process. Thus, we examine the same measure of aftermarket volatility as used in Barry and Jennings (1993)—the natural log of the 1st day's high price scaled by the low price, to determine if the regulation had the intended effect.[15]

In Panel A of Table 5 we provide regression results for four models estimating volatility. The first model is simply a univariate test of volatility between the regulated and pre-regulated periods. The regulation coefficient of 12.49 implies that our measure of volatility was approximately 12.5 percent greater during the post regulated period. In addition to only measuring the effect of SR-NASD-98-98 on volatility, as with our multivariate analysis in Section IV, we attempt to capture relationships between our volatility measure and explanatory variables commonly referenced in the IPO literature. Once we introduce the remaining

[15] See Parkinson (1980) for a detailed discussion of this measure.

independent variables the coefficient decreases to about four percent, but it remains statistically significant at the one-percent level.

*** Table 5 About Here ***

The higher returns for the bubble period documented in Tables II and III lead to the possibility that our results in Panel A are being driven by increased volatility during the bubble period. Thus, in Panel B we delete all issues that went public during this time. The coefficient on *Regulated* drops to approximately 3 percent, but nonetheless remains economically and statistically significant at the one-percent level in all four models considered. The evidence presented here suggests that the regulation may have actually increased first-day volatility rather than reduced it.

Recognizing that the SR-NASD-98-98 regulation only applies to Nasdaq firms, we repeat the analysis in Table 5 using only Nasdaq IPOs in Table 6. As shown, the results in Table 6 are consistent with those presented in Table 5. In Panel A, the regulation coefficient ranges from 10.7 percent in the univariate model to 2.5 percent in our most complete multivariate model; however, it remains significantly significant in all cases considered.

*** Table 6 About Here ***

Of course, once we limit the sample to only Nasdaq issues, the regulated dummy variable becomes essentially a time-trend dummy; therefore, the results in Panel A could be biased by inclusion of the bubble period. This is particularly important for the tech-heavy Nasdaq issues because they are likely to be associated with higher degrees of volatility; thus, in Panel B we delete all bubble period issues from the Nasdaq subsample. The coefficient on *Regulated* drops to approximately 1.7 percent, but it remains economically and statistically significant at the five-percent level in all models. In fact, once accounting for other IPO-related variables, the

coefficient increases to 3 percent with statistical significance at the one-percent level. Again, our evidence suggests that the regulation intended to reduce first-day volatility may have actually accentuated it.

Discussions we had with buy-side market makers who participated in hundreds of IPOs from 1997 to 2003 support our empirical findings. They suggested that the widening of the pre-opening window did allow for a longer price discovery period, but it also enabled market makers to have more time and opportunity to enter and adjust quotes before the issue was released for trading. Consequently, the longer pre-opening window actually motivated a greater flurry of pre-opening quotes and price adjustments.

V. Conclusion

We investigate secondary market returns on the first day of trading for IPOs during the 1997–mid-2004 time period. We document four important findings. First, secondary market returns are large, perhaps exploitable, and persist throughout our sample period. Second, this open-to-close return is strongly related to adjustments in the offer price with respect to the original file range. Third, we find the positive relation between venture-capital backed IPOs and underpricing appears to be driven by secondary market returns, a result previously unaddressed in the academic literature. Finally, we find that first-day aftermarket volatility for Nasdaq IPOs increased after the implementation of a regulation designed to curtail it.

The implications of this study have broad appeal. From an academic perspective, earlier work reports that almost all of the initial return is impounded in the first trade. We find that this is no longer the case. More importantly, the model developed by Benveniste and Spindt (1989), perhaps the most accepted explanation for IPO underpricing, predicts a positive relation between

adjustments in the offer price relative to the initial file range and underpricing. In their model, the sole beneficiaries are the suppliers of information, and any reward for this information should be captured immediately in the first trade. However, we find a positive relation between partial adjustment and open-to-close returns. Their model makes no such predictions about secondary market returns.

This study should also be of interest to investors and regulators for several reasons. First, for investors, we document a 7 percent open-to-close return for Nasdaq IPOs priced above the file range. As far as we know, this one-day return is larger than any other documented aftermarket return in the IPO literature. In fact, this in-sample return would be exploitable even with relatively high trading costs. On the other hand, this study should also be of interest to regulators. Laddering has been blamed for manipulating the stock price on the first day of trading during the bubble period, but our results show that secondary market returns remained high even after laddering was explicitly banned in 2001. Voluntary agreements where a buyer offers to buy more shares in the aftermarket to receive a favorable allocation as opposed to a forced quid-pro-quo type arrangement is permissible. Thus, there is a legal difference between the two such that the quid-pro-quo agreement is illegal, but a voluntary agreement is not and this may contribute to the higher secondary returns post-2001 that we document. Finally, also of interest to regulators, our results suggest that regulation SR-NASD-98-98, which was implemented to reduce instability for Nasdaq IPOs, may have had the undesired effect of exacerbating it.

References

Aggrawal, R., and P. Conroy. "Price Discovery in Initial Public Offerings and the Role of the Lead Underwriter." *Journal of Finance*, 55 (2000), 2903–2922.

Barry, C., and R. Jennings. "The Opening Price Performance of Initial Public Offerings of Common Stock. *Financial Management,* 22 (1993), 54–63.

Benveniste, L., and P. Spindt. "How Investment Bankers Determine the Offer Price and Allocation of New Issues." *Journal of Financial Economics,* 24 (1989), 343–361.

Bradley, D., J. Cooney, B. Jordan, and A. Singh. "Negotiation and the IPO Offer Price: A Comparison of Integer vs. Non-Integer IPOs," *Journal of Financial and Quantitative Analysis,* 39 (2004), 517–540.

Bradley, D., and B. Jordan. "Partial Adjustment to Public Information and IPO Underpricing." *Journal of Financial and Quantitative Analysis,* 37 (2002), 595–616.

Carter, R., and S. Manaster. "Initial Public Offerings and Underwriter Reputation." *Journal of Finance,* 45 (1990), 1045–1067.

Deneen, M., and J. Hooghuis. "Tidal Wave of IPO 'Laddering Litigation' Swamps D&O Market." (2001) Hooguis Inc. law firm.

Hao, G. "Laddering in Initial Public Offerings." University of Missouri Working Paper, (2005).

Hanley, K. "The Underpricing of Initial Public Offerings and the Partial Adjustment Phenomenon." *Journal of Financial Economics,* 34 (1993) 231–250.

Hegde, S., and R. Miller. "Market-Making in Initial Public Offerings of Common Stocks: An Empirical Analysis." *Journal of Financial and Quantitative Analysis,* 24 (1989), 75-90.

Ibbotson, R. "Price Performance of Common Stock New Issues." *Journal of Financial Economics,* 2 (1975), 235–272.

Ibbotson, R., and J. Jaffe. "'Hot Issue' Markets." *Journal of Finance,* 30 (1975) 1027–1042.

Ibbotson, R., J. Sindelar, and J. Ritter. "Initial Public Offerings." *Journal of Applied Corporate Finance,* 7 (1988), 37–45.

Lee, P., and S. Wahal. "Grandstanding, Certification and the Underpricing of Venture Capital Backed IPOs." *Journal of Financial Economics,* 73 (2004), 375-407.

Ljungqvist, A., and W. Wilhelm. "IPO Pricing in the Dot-Com Bubble." *Journal of Finance,* 58 (2003), 723–752.

Logue, D. "On the Pricing of Unseasoned Equity Issues: 1965–1969." *Journal of Financial and Quantitative Analysis,* 8 (1973), 91–103.

Loughran, T., and J. Ritter. "Why Don't Issuers Get Upset About Leaving Money on the Table in IPOs?" *Review of Financial Studies,* 15 (2002), 413–443.

Loughran, T., and J. Ritter."Why has IPO Underpricing Changed Over Time?" *Financial Management,* 33 (2004), 5–37.

Megginson, W., and K.Weiss. "Venture Capitalist Certification in Initial Public Offerings." *Journal of Finance,* 46 (1991), 879–903.

Miller, R., and F. Reilly."An Examination of Mispricing, Returns, and Uncertainty of Initial Public Offerings." *Financial Management,* 16 (1987), 33–38.

Parkinson, M. "Option Pricing: The American Put." *Journal of Business,* 50 (1977), 21-36.

Parkinson, M. "The Extreme Value Method for Estimating the Variance for the Rate of Return." *Journal of Business,* 53 (1980), 61–66.

Ritter, J. "The 'Hot' Issue Market of 1980" *Journal of Business* 57 (1984), 215–240.

Schultz, P. and M. Zaman. "Aftermarket Support and Underpricing of Initial Public Offerings." Journal of Financial Economics, 14 (1994), 199-219.

White, H."A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity." *Econometrica* 48 (1980), 817–838.

Wiggins, J."Empirical Tests of the Bias and Efficiency of the Extreme-Value Variance Estimator for Common Stocks." *Journal of Business* 64 (1991), 417–432.

Table 1. Descriptive statistics

The sample contains 1,320 IPOs issued between January 1, 1997 and June 30, 2004. The sample is restricted to IPOs recorded in Thomson Financial's SDC New Issues Database with an offer price of at least five dollars. We exclude spinoffs, Real Estate Investment Trusts (REITs), unit offers, Savings and Loans, American Depository Receipts (ADRs), closed end investment funds, and firms not listed in the CRSP file. This table provides descriptive statistics for the full sample. *Offer Size* is calculated as total shares sold times the offer price, presented in millions of dollars. *Offer Price* is the price per share offered to primary market investors. *Integer* is a binary variable equal to one if the offer price is an integer, zero otherwise. *Venture Capital* is a binary variable equal to one if the issuing firm is venture-capital backed, zero otherwise. *Nasdaq* is a binary variable equal to one if the IPO is traded on the Nasdaq, zero otherwise. *Tech* is a binary variable equal to one if the issuing firm's business is in a high-tech industry, zero otherwise. *Overhang* is the number of shares retained by insiders divided by the number of shares offered in the IPO. *Partial* is the percentage change from the middle of the original file range to the offer price. *Reputation* is the Carter-Manaster reputation ranking of the lead underwriter of the IPO for the year of the IPO. *Market Lag* is the cumulative return of the Nasdaq composite for the fifteen days prior to the IPO date. *Total Underpricing* is the percentage change from the offer price to the last trade/closing price on the first day of trading. *Offer-to-Open* is the percentage change from the IPO offer price to the first trade/open price on the first day of trading. *Open-to-Close* is the percentage change from the first trade/open price on the first day of trading to the last trade/closing price on the first day of trading. *Volatility* is Parkinson's (1980) estimate of the standard deviation of the intraday returns calculated as the natural log of an issue's 1st day high price divided by the issue's 1st day low price, expressed as a percentage. Offering, opening, and closing prices are collected from Hoover's IPOcentral.com. IPO daily high prices, IPO daily low prices, and daily returns are collected from the Center for Research In Securities Prices (CRSP) file. Carter-Manaster Underwriter Reputation Rankings are collected from Jay Ritter's IPO website.

Variable	N	Mean	Std. Dev.	Minimum	Maximum
Offer Size ($M)	1,320	107.46	257.77	5.00	5,470.00
Offer Price	1,320	14.03	5.21	5.00	53.00
Integer	1,320	0.88	31.84	0.00	1.00
Venture Capital	1,320	0.54	49.84	0.00	1.00
Nasdaq	1,320	0.84	36.30	0.00	1.00
Tech	1,320	0.67	0.47	0.00	1.00
Overhang	1,320	3.55	5.37	0.00	92.48
Partial	1,320	7.08	30.03	–58.33	220.00
Reputation	1,320	7.79	1.81	1.10	9.10
Market Lag	1,320	1.11	6.75	–22.12	23.56
Total Underpricing	1,320	43.55	74.04	–43.23	697.50
Offer-to-Open	1,320	38.18	70.31	–38.46	900.00
Open-to-Close	1,320	3.93	17.41	–48.95	129.26
Volatility	1,320	19.49	15.02	0.31	129.09

Table 2. Univariate Sorts by Exchange of Listing

The sample contains 1,320 IPOs issued between January 1, 1997 and June 30, 2004. The sample is restricted to IPOs recorded in Thomson Financial's SDC New Issues Database with an offer price of at least five dollars. We exclude spinoffs, Real Estate Investment Trusts (REITs), unit offers, Savings and Loans, American Depository Receipts (ADRs), closed end investment funds, and firms not listed in the CRSP file. This table provides mean *Total Underpricing*, *Offer-to-Open*, and *Open-to-Close* returns by exchange of listing for the full sample (January 1, 1997 – June 30, 2004) and across subsamples for IPOs issued prior to the internet bubble period (January 1, 1997 – December 31, 1998), during the internet bubble period (January 1, 1999 – December 31, 2000), and after the internet bubble period (January 1, 2001 – June 30, 2004). The number of observations, *N*, is reported for each category, when applicable. *Total Underpricing* is the percentage change from the offer price to the last trade/closing price on the first day of trading. *Offer-to-Open* is the percentage change from the IPO offer price to the first trade/open price on the first day of trading. *Open-to-Close* is the percentage change from the first trade/open price on the first day of trading to the last trade/closing price on the first day of trading. The *p*-values are for a *t*-test of difference in means between NYSE/AMEX and Nasdaq issues. Equal or unequal variances are assumed based on the outcome of a test of equality of variances. Offering, opening, and closing prices are collected from Hoover's IPOcentral.com.

Panel A: Full Sample of IPOs				
	N	Total Underpricing	Offer-to-Open	Open-to-Close
Full Sample of IPOs	1,320	43.54	38.18	3.93
NYSE / AMEX	206	12.99	11.70	1.00
Nasdaq	1,114	49.20	43.08	4.47
p-Value		(0.0001)	(0.0001)	(0.0001)
Pre Bubble Period (1997 – 1998)	362	18.88	18.12	1.60
NYSE / AMEX	79	13.06	12.65	0.01
Nasdaq	283	20.51	19.66	2.02
p-Value		(0.0440)	(0.0882)	(0.0245)
Bubble Period (1999 – 2000)	704	67.59	58.98	5.59
NYSE / AMEX	49	17.50	16.07	0.96
Nasdaq	658	71.10	61.69	5.92
p-Value		(0.0001)	(0.0001)	(0.0011)
Post Bubble Period (2001 – 2004)	254	12.05	9.10	2.61
NYSE / AMEX	81	10.36	8.28	1.90
Nasdaq	173	12.86	9.50	2.94
p-Value		(0.2261)	(0.4216)	(0.3809)

Table 3. Univariate Sorts by Offer Price Relation to the Original File Range

The sample contains 1,320 IPOs issued between January 1, 1997 and June 30, 2004. The sample is restricted to IPOs recorded in Thomson Financial's SDC New Issues Database with an offer price of at least five dollars. We exclude spinoffs, Real Estate Investment Trusts (REITs), unit offers, Savings and Loans, American Depository Receipts (ADRs), closed end investment funds, and firms not listed in the CRSP file. This table provides mean *Total Underpricing*, *Offer-to-Open*, and *Open-to-Close* returns by file range for the full sample (January 1, 1997 – June 30, 2004) and across subsamples for IPOs issued prior to the internet bubble period (January 1, 1997 – December 31, 1998), during the internet bubble period (January 1, 1999 – December 31, 2000), and after the internet bubble period (January 1, 2001 – June 30, 2004). Panel A presents the results for the full sample, and Panel B presents the results for the Nasdaq subsample. The number of observations, *N*, is reported for each category. *Total Underpricing* is the percentage change from the offer price to the last trade/closing price on the first day of trading. *Offer-to-Open* is the percentage change from the IPO offer price to the first trade/open price on the first day of trading. *Open-to-Close* is the percentage change from the first trade/open price on the first day of trading to the last trade/closing price on the first day of trading. Offering, opening, and closing prices are collected from Hoover's IPOcentral.com.

Panel A: Full Sample of IPOs

	N	Total Underpricing	Offer-to-Open	Open-to-Close
Full Sample of IPOs	1,320	43.54	38.18	3.93
Above File Range	454	97.27	86.74	6.58
Within File Range	578	19.20	15.50	3.16
Below File Range	288	7.73	7.15	1.28
Pre Bubble Period (1997 – 1998)	362	18.88	18.12	1.60
Above File Range	85	40.19	39.57	1.60
Within File Range	178	13.65	11.07	2.29
Below File Range	99	9.99	12.40	0.36
Bubble Period (1999 – 2000)	704	67.59	58.98	5.59
Above File Range	325	121.50	107.80	8.04
Within File Range	261	27.86	22.68	4.32
Below File Range	118	7.00	4.38	1.66
Post Bubble Period (2001 – 2004)	254	12.05	9.10	2.61
Above File Range	44	28.57	22.32	5.41
Within File Range	139	10.03	7.71	2.07
Below File Range	71	5.79	3.68	1.93

Panel B: All Nasdaq IPOs

	N	Total Underpricing	Offer-to-Open	Open-to-Close
All Nasdaq IPOs	1,114	49.20	43.07	4.47
Above File Range	404	105.56	94.20	7.07
Within File Range	465	21.63	17.07	3.90
Below File Range	245	8.58	8.14	1.26
Pre Bubble Period (1997 – 1998)	283	20.51	19.66	2.02
Above File Range	69	42.59	42.59	1.64
Within File Range	135	14.32	10.65	3.24
Below File Range	79	11.80	15.00	0.26
Bubble Period (1999 – 2000)	658	71.09	61.98	5.92
Above File Range	311	125.08	110.91	8.33
Within File Range	239	29.58	23.91	4.73
Below File Range	108	7.48	5.31	1.62
Post Bubble Period (2001 – 2004)	173	12.83	9.48	2.94
Above File Range	24	33.56	25.97	6.32
Within File Range	91	11.57	8.57	2.68
Below File Range	58	6.24	4.07	1.96

Table 4. Multivariate Analysis: Total Underpricing, Offer-to-Open, and Open-to-Close

The sample contains 1,320 IPOs issued between January 1, 1997 and June 30, 2004. The sample is restricted to IPOs recorded in Thomson Financial's SDC New Issues Database with an offer price of at least five dollars. We exclude spinoffs, Real Estate Investment Trusts (REITs), unit offers, Savings and Loans, American Depository Receipts (ADRs), closed end investment funds, and firms not listed in the CRSP file. This table provides OLS regression results for the dependent variables *Total Underpricing, Offer-to-Open*, and *Open-to-Close*. *Offer-to-Open* is the percentage change from the IPO offer price to the first trade/open price on the first day of trading. *Total Underpricing* is the percentage change from the offer price to the last trade/closing price on the first day of trading. *Open-to-Close* is the percentage change from the first trade/open price on the first day of trading to the last trade/closing price on the first day of trading. We present results for the full sample of IPOs in Panel A and the full sample of IPOs excluding bubble period (1999 and 2000) Issues in Panel B. *Integer* is a binary variable equal to one if the offer price is an integer, zero otherwise. *Venture Capital* is a binary variable equal to one if the issuing firm is venture-capital backed, zero otherwise. *Overhang* is the number of shares retained by insiders divided by the number of shares offered in the IPO. *Tech* is a binary variable equal to one if the issuing firm's business is in a high-tech industry, zero otherwise. *Partial* is the percentage change from the middle of the original file range to the offer price. *Reputation* is the Carter-Manaster reputation ranking of the lead underwriter of the IPO for the year of the IPO. *Log Size* is the natural logarithm of the offer size of the IPO. *Nasdaq* is a binary variable equal to one if the IPO is listed on Nasdaq, zero otherwise. *Market Lag* is the cumulative return of the Nasdaq composite for the fifteen days prior to the IPO date. Year of offering dummy variables are included, but not reported. We calculate the *p*-value for each coefficient estimate, reported in the parentheses to the right of the coefficient estimate, using White's (1980) heteroskedasticity-consistent standard errors (HCSEs). Offering, opening, and closing prices are collected from Hoover's IPOcentral.com. IPO daily high prices, IPO daily low prices, and daily returns are collected from the Center for Research In Securities Prices (CRSP) file. Carter-Manaster Underwriter Reputation Rankings are collected from Jay Ritter's IPO website.

Panel A: Full Sample of IPOs						
Variable	Total Underpricing		Offer-to-Open		Open-to-Close	
	Estimate	*p*-Value	Estimate	*p*-Value	Estimate	*p*-Value
Intercept	0.679	(0.0982)	0.523	(0.1904)	0.102	(0.4438)
Integer	0.028	(0.5475)	0.017	(0.7220)	0.010	(0.5077)
Venture Capital	0.088	(0.0126)	0.049	(0.1517)	0.027	(0.0165)
Overhang	0.010	(0.0004)	0.011	(0.0001)	0.001	(0.2356)
Tech	0.101	(0.0097)	0.110	(0.0038)	0.002	(0.8656)
Partial	1.431	(0.0001)	1.339	(0.0001)	0.097	(0.0001)
Reputation	0.024	(0.0147)	0.021	(0.0229)	0.003	(0.4267)
Log Size	−0.044	(0.0614)	−0.035	(0.1219)	−0.006	(0.4159)
Nasdaq	0.019	(0.7027)	0.015	(0.7604)	0.008	(0.5993)
Market Lag	0.872	(0.0002)	0.822	(0.0002)	−0.006	(0.9404)
Offer-to-Open					−0.040	(0.0001)
Observations	1,320		1,320		1,320	
Adjusted R^2	48.81		46.21		3.92	

Panel B: Full Sample of IPOs Excluding Bubble Period Issues						
Variable	Total Underpricing		Offer-to-Open		Open-to-Close	
	Estimate	*p*-Value	Estimate	*p*-Value	Estimate	*p*-Value
Intercept	0.405	(0.2187)	0.301	(0.4932)	0.126	(0.3084)
Integer	0.009	(0.7587)	0.010	(0.8033)	0.004	(0.6837)
Venture Capital	0.087	(0.0185)	0.035	(0.3751)	0.025	(0.0442)
Overhang	0.006	(0.0009)	0.008	(0.0019)	0.001	(0.7252)
Tech	0.094	(0.0009)	0.102	(0.0074)	0.015	(0.0841)
Partial	0.504	(0.0001)	0.441	(0.0001)	0.057	(0.0108)
Reputation	0.013	(0.1649)	0.015	(0.2180)	0.001	(0.6577)
Log Size	−0.023	(0.2423)	−0.020	(0.4381)	−0.006	(0.4169)
Nasdaq	0.001	(0.9904)	0.001	(0.9899)	0.013	(0.5539)
Market Lag	0.650	(0.0029)	0.817	(0.0050)	−0.014	(0.8486)
Offer-to-Open					−0.046	(0.0001)
Observations	616		616		616	
Adjusted R^2	17.21		10.49		4.79	

Table 5. Multivariate Analysis: Volatility

The sample contains 1,320 IPOs issued between January 1, 1997 and June 30, 2004. The sample is restricted to IPOs recorded in Thomson Financial's SDC New Issues Database with an offer price of at least five dollars. We exclude spinoffs, Real Estate Investment Trusts (REITs), unit offers, Savings and Loans, American Depository Receipts (ADRs), closed end investment funds, and firms not listed in the CRSP file. This table provides OLS regression results for the dependent variable *Volatility*, Parkinson's (1980) estimate of the standard deviation of the intraday returns calculated as the natural log of an issue's 1st day high price divided by the issue's 1st day low price, expressed as a percentage. We present results for the full sample of IPOs in Panel A and the full sample of IPOs excluding bubble period (1999 and 2000) issues in Panel B. *Regulated* is a binary variable equal to one if the IPO is a Nasdaq IPO subject to SR-NASD-98-98 which became effective on January 26, 1999, zero otherwise. *Integer* is a binary variable equal to one if the offer price is an integer, zero otherwise. *Venture Capital* is a binary variable equal to one if the issuing firm is venture-capital backed, zero otherwise. *Overhang* is the number of shares retained by insiders divided by the number of shares offered in the IPO. *Tech* is a binary variable equal to one if the issuing firm's business is in a high-tech industry, zero otherwise. *Partial* is the percentage change from the middle of the original file range to the offer price. *Reputation* is the Carter-Manaster reputation ranking of the lead underwriter of the IPO for the year of the IPO. *Log Size* is the natural logarithm of the offer size of the IPO. *Market Lag* is the cumulative return of the Nasdaq composite for the fifteen days prior to the IPO date. Year of offering dummy variables are included, but not reported. We calculate the *p*-value for each coefficient estimate, reported in the parentheses to the right of the coefficient estimate, using White's (1980) heteroskedasticity-consistent standard errors (HCSEs). Offering, opening, and closing prices are collected from Hoover's IPOcentral.com. IPO daily high prices, IPO daily low prices, and daily returns are collected from the Center for Research In Securities Prices (CRSP) file. Carter-Manaster Underwriter Reputation Rankings are collected from Jay Ritter's IPO website.

Panel A: Full Sample of IPOs

	Volatility Model 1		Volatility Model 2		Volatility Model 3		Volatility Model 4	
Variable	Estimate	*p*-Value	Estimate	*p*-Value	Estimate	*p*-Value	Estimate	*p*-Value
Intercept	9.497	(0.0001)	40.919	(0.0001)	39.543	(0.0001)	36.754	(0.0001)
Regulated	12.485	(0.0001)	4.582	(0.0001)	4.524	(0.0001)	4.104	(0.0001)
Integer			1.233	(0.2397)	1.209	(0.2472)	0.901	(0.3261)
Venture Capital			2.057	(0.0070)	1.960	(0.0099)	1.507	(0.0487)
Overhang			0.091	(0.1345)	0.068	(0.2562)	0.032	(0.5517)
Tech			3.549	(0.0001)	3.317	(0.0001)	3.232	(0.0001)
Partial			9.103	(0.0001)	6.231	(0.0001)	3.170	(0.0149)
Reputation			−0.009	(0.9668)	−0.059	(0.7823)	−0.143	(0.4445)
Log Size			−1.981	(0.0001)	−1.887	(0.0001)	−1.696	(0.0001)
Market Lag			13.010	(0.0091)	11.217	(0.0247)	10.993	(0.0123)
Offer-to-Open					2.137	(0.0001)	3.412	(0.0001)
Open-to-Close							32.122	(0.0001)
Observations	1,320		1,320		1,320		1,320	
Adjusted R^2	27.95		40.80		41.29		54.69	

Panel B: Full Sample of IPOs Excluding Bubble Period Issues

	Volatility Model 1		Volatility Model 2		Volatility Model 3		Volatility Model 4	
Variable	Estimate	*p*-Value	Estimate	*p*-Value	Estimate	*p*-Value	Estimate	*p*-Value
Intercept	9.641	(0.0001)	36.617	(0.0001)	33.444	(0.0001)	30.999	(0.0001)
Regulated	3.002	(0.0001)	2.822	(0.0008)	3.087	(0.0001)	2.924	(0.0001)
Integer			–0.573	(0.4376)	–0.650	(0.3517)	−0.076	(0.2294)
Venture Capital			1.758	(0.0127)	1.973	(0.0031)	1.793	(0.0031)
Overhang			0.069	(0.1110)	0.024	(0.5426)	0.030	(0.4164)
Tech			2.830	(0.0001)	2.210	(0.0005)	1.767	(0.0022)
Partial			9.312	(0.0001)	6.631	(0.0001)	5.014	(0.0005)
Reputation			−0.092	(0.6699)	−0.189	(0.3539)	−0.219	(0.2356)
Log Size			−1.541	(0.0004)	−1.361	(0.0008)	−1.239	(0.0008)
Market Lag			11.596	(0.0243)	6.619	(0.1762)	6.411	(0.1491)
Offer-to-Open					5.869	(0.0001)	7.256	(0.0001)
Open-to-Close							30.187	(0.0001)
Observations	616		616		616		616	
Adjusted R^2	7.87		18.33		27.09		39.88	

Table 6. Multivariate Analysis: Volatility for Nasdaq IPOs

The sample contains 1,320 IPOs issued between January 1, 1997 and June 30, 2004, of which 1,114 are Nasdaq IPOs. The sample is restricted to IPOs recorded in Thomson Financial's SDC New Issues Database with an offer price of at least five dollars. We exclude spinoffs, Real Estate Investment Trusts (REITs), unit offers, Savings and Loans, American Depository Receipts (ADRs), closed end investment funds, and firms not listed in the CRSP file. This table provides OLS regression results for the dependent variable *Volatility*, Parkinson's (1980) estimate of the standard deviation of the intraday returns calculated as the natural log of an issue's 1st day high price divided by the issue's 1st day low price, expressed as a percentage. We present results for all Nasdaq IPOs in Panel A and Nasdaq IPOs excluding bubble period (1999 and 2000) issues in Panel B. *Regulated* is a binary variable equal to one if the IPO is a Nasdaq IPO subject to SR-NASD-98-98 which became effective on January 26, 1999, zero otherwise. *Integer* is a binary variable equal to one if the offer price is an integer, zero otherwise. *Venture Capital* is a binary variable equal to one if the issuing firm is venture-capital backed, zero otherwise. *Overhang* is the number of shares retained by insiders divided by the number of shares offered in the IPO. *Tech* is a binary variable equal to one if the issuing firm's business is in a high-tech industry, zero otherwise. *Partial* is the percentage change from the middle of the original file range to the offer price. *Reputation* is the Carter-Manaster reputation ranking of the lead underwriter of the IPO for the year of the IPO. *Log Size* is the natural logarithm of the offer size of the IPO. *Market Lag* is the cumulative return of the Nasdaq composite for the fifteen days prior to the IPO date. Year of offering dummy variables are included, but not reported. We calculate the *p*-value for each coefficient estimate, reported in the parentheses to the right of the coefficient estimate, using White's (1980) heteroskedasticity-consistent standard errors (HCSEs). Offering, opening, and closing prices are collected from Hoover's IPOcentral.com. IPO daily high prices, IPO daily low prices, and daily returns are collected from the Center for Research In Securities Prices (CRSP) file. Carter-Manaster Underwriter Reputation Rankings are collected from Jay Ritter's IPO website.

Panel A: All Nasdaq IPOs

	Volatility Model 1		Volatility Model 2		Volatility Model 3		Volatility Model 4	
Variable	Estimate	*p*-Value	Estimate	*p*-Value	Estimate	*p*-Value	Estimate	*p*-Value
Intercept	11.003	(0.0001)	39.964	(0.0001)	37.738	(0.0001)	35.172	(0.0005)
Regulated	10.746	(0.0001)	2.835	(0.0055)	2.831	(0.0153)	2.537	(0.0219)
Integer			1.928	(0.1466)	1.911	(0.1490)	1.451	(0.2101)
Venture Capital			2.109	(0.0130)	2.034	(0.0163)	1.003	(0.0417)
Overhang			0.089	(0.1677)	0.070	(0.2806)	0.035	(0.5387)
Tech			3.351	(0.0007)	3.151	(0.0014)	3.287	(0.0001)
Partial			8.280	(0.0001)	5.811	(0.0005)	2.640	(0.0725)
Reputation			−0.029	(0.9049)	−0.072	(0.7691)	−0.127	(0.5526)
Log Size			−1.931	(0.0055)	−1.848	(0.0077)	−1.622	(0.0075)
Market Lag			13.565	(0.0165)	12.027	(0.0339)	12.011	(0.0154)
Offer-to-Open					1.782	(0.0073)	3.101	(0.0001)
Open-to-Close							32.097	(0.0001)
Observations	1,114		1,114		1,114		1,114	
Adjusted R^2	30.16		35.36		35.73		50.89	

Panel B: Nasdaq IPOs Excluding Bubble Period Issues

	Volatility Model 1		Volatility Model 2		Volatility Model 3		Volatility Model 4	
Variable	Estimate	*p*-Value	Estimate	*p*-Value	Estimate	*p*-Value	Estimate	*p*-Value
Intercept	10.914	(0.0001)	29.742	(0.0071)	28.357	(0.0067)	26.151	(0.0056)
Regulated	1.729	(0.0208)	2.796	(0.0302)	3.263	(0.0077)	3.085	(0.0052)
Integer			0.227	(0.8084)	0.382	(0.6662)	−0.661	(0.4089)
Venture Capital			2.038	(0.0119)	2.271	(0.0031)	1.997	(0.0040)
Overhang			0.073	(0.0176)	0.034	(0.4380)	0.038	(0.3306)
Tech			2.669	(0.0007)	2.070	(0.0057)	1.819	(0.0071)
Partial			7.686	(0.0001)	5.513	(0.0038)	4.035	(0.0191)
Reputation			−0.039	(0.8833)	−0.052	(0.8389)	−0.001	(0.9962)
Log Size			−1.222	(0.0721)	−1.144	(0.0751)	−1.070	(0.0653)
Market Lag			14.603	(0.0191)	9.449	(0.0408)	9.508	(0.0756)
Offer-to-Open					5.260	(0.0001)	6.684	(0.0001)
Open-to-Close							30.099	(0.0001)
Observations	456		456		456		456	
Adjusted R^2	7.33		12.51		21.71		36.20	