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Negotiation and the IPO Offer Price: A Comparison of Integer vs. Non-Integer IPOs

Daniel J. Bradley, John W. Cooney, Jr., Bradford D. Jordan, and Ajai K. Singh*

Abstract

We investigate the pricing of 4,989 equity IPOs with offer dates between 1981 and 2000. Approximately three-fourths of these IPOs have integer offer prices. Average initial returns for IPOs with integer offer prices are significantly higher (24.5%) than those priced on the fraction of the dollar (8.1%). This result is robust through time and after conditioning for other effects known to influence initial returns. We hypothesize that integer vs. fractional dollar IPOs are the result of negotiations between the issuing firm and underwriter. Under this negotiation hypothesis, the frequency of integer pricing should be an increasing function of the offer price and the degree of uncertainty surrounding the value of the firm. Empirical evidence, supportive of the negotiation hypothesis, is presented.

I. Introduction

We examine a relatively unexplored aspect of IPO pricing, the information content of integer vs. non-integer offer prices. For a sample of 4,989 U.S. IPOs from 1981–2000, we document that 75.3% are priced on the integer. More importantly, we find that the average initial return for integer IPOs is much higher than for non-integer IPOs, 24.5% vs. 8.1%, respectively.

This pattern is robust. Higher initial returns for whole dollar offerings occur in 18 of the 20 years of our sample, and the difference widens through time. The mean initial return for integer offerings is 3.1 percentage points higher during the 1980s, 6.4 percentage points higher during the 1991–1998 period, and 64.2 percentage points higher during the IPO "bubble" period (1999–2000). The underpricing difference persists after controlling for other variables related to IPO

* Bradley, dbradle@clemson.edu, College of Business and Behavioral Science, 324B Sirrine Hall, Clemson University, Clemson, SC 29634; Cooney, jcooney@ba.ttu.edu, Rawls College of Business Administration, Texas Tech University, Lubbock, TX 79409; Jordan, bjordan@uky.edu, Gatton College of Business and Economics, University of Kentucky, Lexington, KY 40506; and Singh, aks8@po.cwru.edu, Weatherhead School of Management, Case Western Reserve University, 10900 Euclid Avenue, Cleveland, OH 44106. We thank Lynn-Ann Gries, Susan Jordan, Jonathan Karpoff (the editor), an anonymous referee, Alexander Ljungqvist, Tim Loughran, Jay Ritter, seminar participants at the 2002 European Financial Management Association meetings, the 2002 Financial Management Association meetings, the University of Kentucky, Louisiana State University, and Texas Tech University, and representatives at Goldman Sachs & Co., McDonald Investments, and William Blair & Co. for providing valuable comments and suggestions.

underpricing. In fact, we find only two consistent effects in all three periods, the integer effect and the partial adjustment effect (i.e., the positive relation between initial returns and the revision in offer prices).

We also examine the relation between whole dollar and fractional pricing and the partial adjustment phenomenon. Existing explanations predict a positive monotonic relation between revisions in offer prices and underpricing. However, we find that IPOs offered at integers are often more underpriced, on average, than those priced on the fraction immediately above. For example, we find that IPOs offered at an integer high file price are underpriced more than those priced on the fraction immediately above the high.

We propose an explanation for these results based on Harris's (1991) costly negotiation hypothesis, in which the frequency of rounded prices is an increasing function of the stock price and uncertainty concerning valuation. Specifically, we hypothesize that the issuing firm and its underwriter are more likely to negotiate from a set of rounded prices when the anticipated offer price is high and/or when there is a large degree of aftermarket price uncertainty. With a lower stock price and/or less uncertainty, negotiations should revolve around a finer set of prices, resulting in more fractional IPOs.

We present evidence consistent with this hypothesis. First, we find that the frequency of whole dollar IPOs increases with the offer price. For low-priced IPOs (i.e., \$5–\$9.99), 65.5% are priced on the whole dollar. The percentage of whole dollar IPOs increases to 76.0% for medium-priced offerings (i.e., between \$10 and \$14.99), and to 85.8% for high-priced offerings (i.e., those priced at \$15 and above).

Second, we find a connection between integer pricing and several uncertainty measures. Both the cross-sectional standard deviation of initial returns and the ex post standard deviation of daily stock returns are higher for IPOs priced on the integer. Empirical tests also confirm that IPOs with integer initial file prices have final offer prices that deviate further from the initial filing range.

Third, integer initial file prices are associated with higher price levels and greater degrees of uncertainty, and issues with both integer file ranges and integer final offer prices are much more underpriced than issues with a fractional price at either stage. The least undervalued are issues with fractional prices at both the filing and offer dates.

Finally, we argue that investment banks have an incentive to underprice the higher uncertainty integer offerings more severely than fractional offerings. The reasons include the need to manage underwriting risk and to reward purchasing investors for revealing their private information. This incentive leads to overall higher initial returns for the integer IPOs and also explains the observed "zigzag" pattern for the partial adjustment phenomenon.

The remainder of the paper is organized as follows. Section II describes the data and provides some preliminary results. Section III reports the extent of underpricing for whole dollar and fractional offerings. We discuss the negotiation hypothesis and the results of our empirical tests in Section IV. Section V concludes.

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II. Data Description

We gather our sample from Thomson Financial's Securities Data Company (SDC) New Issues database for the period January 1, 1981 through December 31, 2000.[1] Consistent with previous IPO studies, we eliminate withdrawn offerings, rights offerings, reverse LBOs, spinoffs, units, limited partnerships and trusts, ADRs, shares of beneficial interests, REITs, closed-end funds, corporations incorporated outside the U.S., IPOs with final offer prices below $5, IPOs with a midpoint of the original filing range below $5, and IPOs with total proceeds less than $5 million.[2] We also eliminate IPOs with missing information on the name of the lead underwriter and/or high or low file prices, along with firms not identified on the Center for Research in Security Prices (CRSP) database and firms with insufficient returns to calculate the ex post standard deviation of daily stock returns. Our final sample contains 4,989 IPOs, of which 3,757 (75.3%) are priced at the whole dollar.

We first calculate *Initial Return* (i.e., the percentage return from the offer price to the closing stock price on the first day of trading less the contemporaneous CRSP value-weighted index return) for the two samples. Whole dollar IPOs are underpriced by 24.5% (median = 9.0%) compared to 8.1% (median = 3.9%) for fractional IPOs. This difference in means of 16.4% (and medians of 5.0%) is not only statistically significant (p-value ≤ 0.0001), but economically large as well.[3]

Figure 1 presents the mean initial return for the two groups by year. Integer offerings have higher initial returns for 18 of the 20 years. Means for the integer sample are statistically greater (at the 10% significance level) in 12 years. The difference between the mean initial returns is generally higher in the 1990s than the 1980s, and it is dramatically higher in the bubble period of 1999 and 2000. In these two years, the mean initial returns for integer IPOs are 77.0% and 60.7%, respectively, compared to 7.8% and 1.9% for the non-integer sample.[4]

Non-integer prices are more common for lower priced IPOs. Of the 1,547 offerings priced between $5 and $9.99, 34.5% (533 offerings) are priced on the fraction. This proportion falls to 24.0% (516 of 2,152 offerings) in the $10 to $14.99 price range and 14.2% (183 of 1,290 offerings) for IPOs priced at $15 and above.

[1] We thank Jay Ritter for providing a list of several corrections to the SDC database, all of which we have incorporated in this study. The corrections are located at http://bear.cba.ufl.edu/ritter/.

[2] Empirical studies typically eliminate IPOs with offer prices below $5. We also eliminate IPOs with a filing range midpoint less than $5. Using the first, but not the second requirement, introduces a bias by including offerings that amend from a filing range midpoint below $5 to an offer price above $5, but excluding offerings that amend from above $5 to an offer price below $5. Our dual requirement eliminates this bias.

[3] In two recent papers, Mola and Loughran (2004) and Corwin (2003) document that seasoned equity offerings (SEOs) are often priced on integers. Similar to the findings of our study, SEOs priced on the integer are discounted more (i.e., priced lower) than fractionally priced SEOs. However, the magnitude of the SEO discount is much smaller than the degree of underpricing of IPOs found in this study.

[4] Mola and Loughran (2004) briefly compare price clustering on the SEO and IPO markets and find results similar to those in Figure 1. Chiang and Harikumar (2002) examine an earlier period (1975–1984) than the one used in our study and also find that IPOs with integer offer prices are underpriced more than those with fractional offer prices.

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FIGURE 1
Initial Returns by Year: Integer vs. Non-Integer IPOs

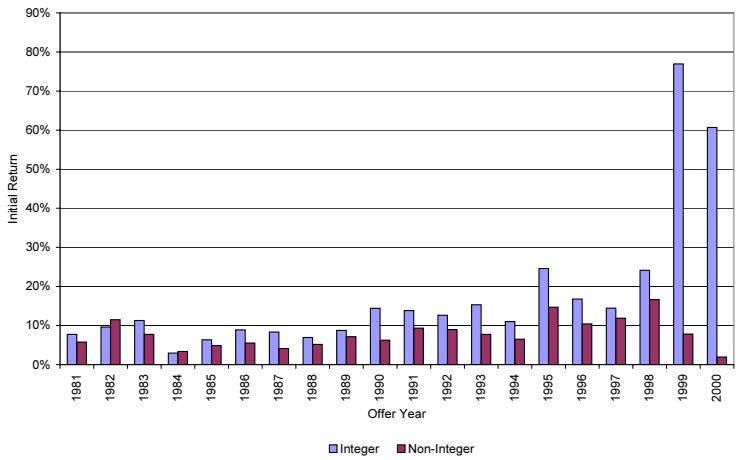


Figure 1 plots average initial returns by year of offering for 4,989 IPOs priced on the integer and non-integer. IPO data are collected from Thomson Financial's Securities Data Company (SDC) New Issues database and from CRSP for offerings from January 1, 1981 to December 31, 2000.

Mean initial returns also increase across these three offer price zones. In other words, higher priced issues are, on average, both more underpriced and more likely to be priced on the integer. Nonetheless, as Graph A of Figure 2 shows, whole dollar IPOs are more underpriced than non-integer IPOs in each offer price range, and the differences are significant at the 1% level.

Grouping IPOs by price range introduces a significant bias. Compared to the population, the highest price range includes more issues with upward adjustments in the offer price relative to downward adjustments because issues that revise upward across the $15 threshold are in the subsample, but those that revise downward across $15 are not. The opposite is true for the lowest price range. Because of the partial adjustment phenomenon, issues with upward (downward) revisions are much more (less) underpriced than other issues.

To investigate the effect of this bias, Graph B of Figure 2 duplicates Graph A except that IPOs are grouped based on the original mid-file price. This switch has a dramatic impact. Now there is relatively little difference in underpricing across the three price ranges, and there is a consistent pattern of less underpricing for non-integer offerings. In all three cases, the differences are economically and statistically significant.

Figure 2 also shows that the bias introduced by the partial adjustment phenomenon is relatively large for integer IPOs, but not for non-integer issues. An implication is that the partial adjustment effect may be different for integer vs. non-integer offerings. We explore this question in detail in a subsequent section.

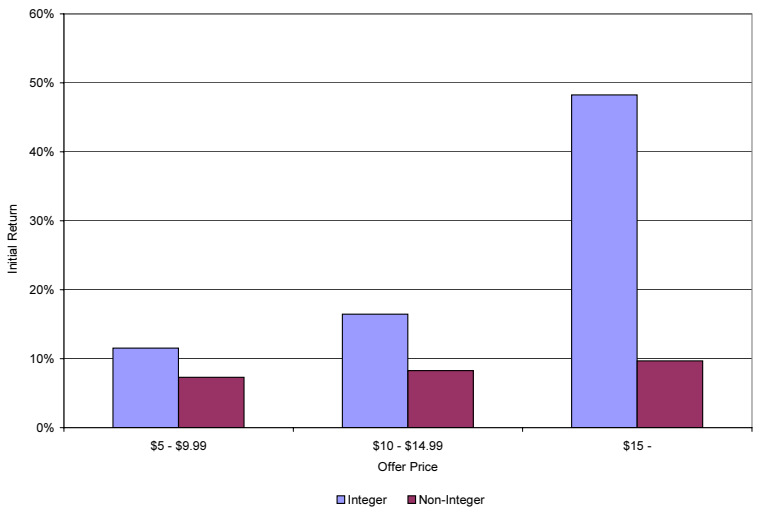
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FIGURE 2

Initial Returns by Offer Price and Filing Range Midpoint: Integer vs. Non-Integer IPOs

Graph A. Initial Returns by Offer Price



Graph B. Initial Returns by Filing Range Midpoint

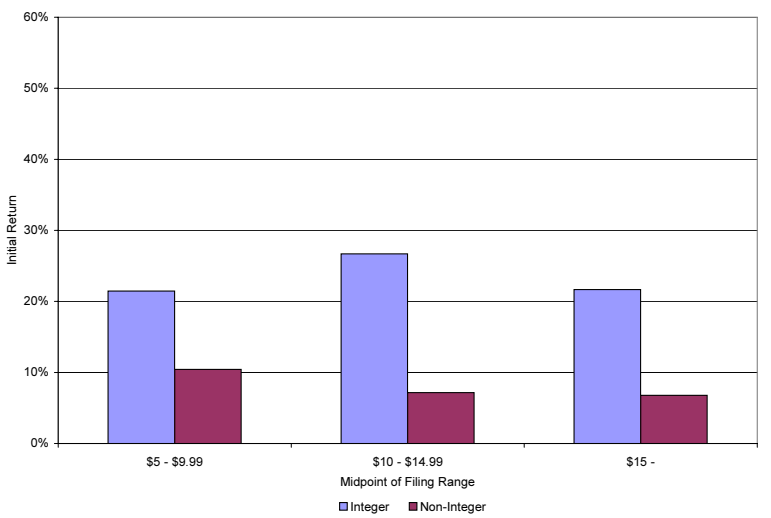


Figure 2 plots average initial returns by the offer price (Graph A) and by the original filing range midpoint (Graph B) for 4,989 IPOs priced on the integer and non-integer. IPO data are collected from Thomson Financial's Securities Data Company (SDC) New Issues database and from CRSP for offerings from January 1, 1981 to December 31, 2000.

III. Integer vs. Non-Integer IPOs: A Closer Look

The results thus far strongly suggest that integer IPOs are more underpriced than non-integer IPOs. Of course, it could be that integer pricing proxies for other issue characteristics, so we expand our analysis to examine other factors associated with IPO underpricing.

A. Univariate Analyses of Issue Characteristics

Table 1 presents descriptive statistics on the two types of IPOs. As previously noted, integer IPOs are more underpriced, 24.5% vs. 8.1%. Integer IPOs have a higher average offer price ($12.39) than fractional IPOs ($11.22). Consistent with the higher offer price, integer IPOs have been, on average, revised 2.3% above the original midpoint of the filing range, while fractional offerings have been revised down 4.0%.

The next variable, *CM-Rank*, is the Carter and Manaster (1990) measure of underwriter prestige as updated by Carter, Dark, and Singh (1998) and Loughran and Ritter (2003). The rankings range from 0 to 9, with 0 representing underwriters of the lowest prestige. IPOs with integer prices have, on average, more prestigious lead underwriters than those with fractional prices, 7.3 vs. 7.0.

Habib and Ljungqvist (2001) argue that issuers care most about underpricing when they are selling a large portion of the firm. To evaluate this effect, we calculate *Overhang*, pre-IPO shares retained scaled by shares offered in the IPO, and *Secondary*, a dummy variable equal to 1 if secondary shares are sold in the IPO. As shown, *Overhang* is larger for the integer sample. The percentage of non-integer IPOs with secondary shares sold (45.2%) is greater than the percentage for integer IPOs (41.1%).

Lag Market is the 21-trading day (i.e., one-month) compounded market return ending one day before the IPO calculated using the CRSP value-weighted index. *Lag IPO* is a simple average of the market-adjusted initial return for all IPOs (within our sample) offered in the month prior to the sample IPO. *Lag Market* is higher for fractional offerings. However, *Lag IPO* is higher for integer offerings. The difference for *Lag IPO* is large (24.7% vs. 13.4%), but it falls to 13.9% vs. 11.4% if the 1999–2000 subsample is excluded. This difference is still statistically significant at the 0.01% level.

Analysis of the CPI-adjusted offer size shows that integer IPOs are larger than non-integer IPOs. The next two variables, *Venture* and *Tech*, are dummy variables taking a value of 1 for venture capital-backed and "high-tech" IPOs, respectively.[5,6] Integer IPOs are much more likely to be VC-backed (48.4% vs.

[5] *Venture* has appeared in the literature as an important determinant of the amount of underpricing. Earlier research argued that VC-backed firms played a "certification role," resulting in lower initial returns (Barry, Muscarella, Peavy, and Vetsuypens (1990) and Megginson and Weiss (1991)). Recent evidence suggests that this effect may be limited to low-price offerings (Bradley, Cooney, Dolvin, and Jordan (2003)) and may have reversed or is non-existent for higher priced offerings (Bradley and Jordan (2002) and Hamao, Packer, and Ritter (2000)).

[6] In the SDC database, firms are classified as "high-tech" based on 4-digit SIC codes, but the application is somewhat inconsistent. We obtained the underlying codes from SDC and applied them to our sample.

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TABLE 1

Descriptive Statistics: Integer vs. Non-Integer IPOs

Table 1 presents descriptive statistics for the integer and non-integer samples for the following variables:

Initial Return is the percentage change from the offer price to the closing stock price on the first day of trading less the contemporaneous CRSP value-weighted index return.

Offer Price is the offer price of the IPO.

Partial is the percentage difference between the offer price and the midpoint of the original file range.

CM-Rank is the Carter and Manaster (1990) underwriter ranking, as updated by Carter, Dark, and Singh (1998) and Loughran and Ritter (2003) (0 = low ranking, 9 = high ranking).

Overhang is measured as shares retained by existing stockholders divided by shares sold in the IPO.

Secondary is a dummy variable equal to 1 if the IPO includes shares sold by existing stockholders, 0 otherwise.

Lag Market is the compounded market return for the 21 trading days (i.e., one month) prior to the IPO date using the CRSP value-weighted index as a proxy for the market.

Lag IPO is the average market-adjusted IPO initial return for all sample IPOs for the month prior to the IPO date.

Offer Size is the CPI-adjusted, 1982–1984 = 100, total proceeds of the IPO in millions (excluding proceeds from the exercise of the over-allotment option).

Venture is a dummy variable equal to 1 if the IPO firm is venture capital-backed, 0 otherwise.

Tech is a dummy variable equal to 1 if the IPO firm is in a high-tech industry, 0 otherwise.

Multiple Class is a dummy variable equal to 1 if the IPO firm has multiple classes of stock, 0 otherwise.

Volatility is the standard deviation of the market-adjusted daily stock returns for the 63-trading day period from the seventh day of trading to the 69th day of trading (i.e., a three-month period). The CRSP value-weighted index return is used as a proxy for the market return.

NYSE/AMEX is a dummy variable equal to 1 if the IPO firm is listed on the NYSE or AMEX after the IPO, 0 otherwise.

	Integer		Non-Integer		
Variable	*N*	Mean	*N*	Mean	*p*-Value
Initial Return	3,757	24.5%	1,232	8.1%	0.0001
Offer Price	3,757	$12.39	1,232	$11.22	0.0001
Partial	3,757	2.3%	1,232	−4.0%	0.0001
CM-Rank	3,757	7.3	1,232	7.0	0.0001
Overhang	3,757	3.0	1,232	2.4	0.0001
Secondary	3,757	41.1%	1,232	45.2%	0.0111
Lag Market	3,757	1.4%	1,232	1.6%	0.0990
Lag IPO	3,747	24.7%	1,230	13.4%	0.0001
Offer Size	3,757	$33.0	1,232	$27.1	0.0178
Venture	3,757	48.4%	1,232	31.1%	0.0001
Tech	3,757	44.9%	1,232	27.8%	0.0001
Multiple Class	3,757	5.4%	1,232	6.0%	0.4550
Volatility	3,757	4.4%	1,232	3.4%	0.0001
NYSE/AMEX	3,757	9.1%	1,232	11.3%	0.0281

The *p*-values are for a *t*-test of difference in means. Equal or unequal variances are assumed based on the outcome of a test of equality of variances. IPO data are collected from Thomson Financial's Securities Data Company (SDC) New Issues database and from CRSP for 4,989 offerings from January 1, 1981 to December 31, 2000.

31.1%) and high-tech (44.9% vs. 27.8%). The multiple shares class dummy, *Multiple Class*, is motivated by the work of Smart and Zutter (2003). Dual-class stock is observed at about the same frequency for integer and non-integer offerings.[7] However, *Volatility*, the standard deviation of the market-adjusted daily stock returns for the 63-trading day period from the seventh day of trading to the 69th day of trading (i.e., a three-month period), is much higher for the integer sample (4.4% vs. 3.4%, respectively).[8] *NYSE/AMEX* is a dummy variable taking on a value of 1 for NYSE/AMEX-listed IPOs. Non-integer IPOs are more likely to be NYSE/AMEX listed, 11.3% compared to 9.1%.

[7]The sample of dual-class IPOs was primarily gathered from Jay Ritter's Web site http://bear.cba.ufl.edu/ritter/.

[8]*Volatility* is calculated over, at most, a 63-trading day period. If CRSP reports a missing return for day t, we exclude day t and day $t + 1$ from the analysis.

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B. Multivariate Analyses

Our univariate comparisons in Table 1 show that significant differences exist between integer and non-integer IPOs. We use a multiple regression to evaluate whether the integer vs. non-integer classification simply proxies for other issue characteristics. The dependent variable is *Initial Return*. The independent variables are as follows:

Integer = A dummy variable equal to 1 if the offer price is on the whole dollar;

Offer Range = Two dummy variables for the offer price range. The first, *Medium Offer Price*, takes on a value of 1 if the offer price is in the \$10–\$14.99 range. The second, *High Offer Price*, equals 1 if the offer price is in the \$15 and above range. The low range dummy is the omitted category in the regression.

Partial = Three variables for the offer price adjustment. The first, *Above*, is the percentage difference between the final offer price and the original file midpoint for issues that are priced above the original file range, and 0 otherwise. The second, *Within*, is the percentage difference for issues that are priced within the original file range, and 0 otherwise; and the third, *Below*, is the percentage difference for issues that are priced below the original file range, and 0 otherwise;

CM-Rank = Three dummy variables for the Carter and Manaster (1990) ranks. The first, *CM9*, equals 1 if the rank is 9 (the highest possible). The second, *CM8*, equals 1 if the rank is 8–8.9. The third, *CM67*, equals 1 if the rank is 6–7.9. The lowest ranking (0–5.9) is the omitted category;[9]

Log Size = the natural log of the CPI-adjusted, 1982–1984 = 100, total proceeds of the IPO in millions (excluding proceeds from the exercise of the over-allotment option); and

Year Dummies = 1 for each in the 1982–2000 period; 1981 is the omitted year.

The remaining independent variables (*Overhang*, *Secondary*, *Lag Market*, *Lag IPO*, *Venture*, *Tech*, *Multiple Class*, *Volatility*, and *NYSE/AMEX*) are as defined in the previous section.

In the regression, we use multiple dummy variables for the offer price ranges instead of a single variable equal to the offer price. With a single variable, the implicit assumption is that the effect is monotonic, but there is evidence of a "U-shaped" relation between offer prices and underpricing (Fernando, Krishnamurthy, and Spindt (2002)). For our price adjustment variable, we follow Bradley and Jordan (2002) and use multiple variables to allow for an asymmetric response to upward and downward adjustments. Similarly, we use dummy variables for the Carter and Manaster (1990) rankings to allow for nonlinearities in the underwriting/underpricing relation.

We examine the entire sample period and three subsamples: 1981–1990, 1991–1998, and 1999–2000.[10] In the two later subsamples (when the data become generally available), we include *High20*, a dummy variable equal to 1 if the final

[9]This division of the underwriter rankings assigns approximately one-fourth of the observations to each dummy.

[10]Year of offering dummies depend on the sample period, with the first year of each subsample excluded.

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offer price is within the interval from 20% above the high end of the final file range down to the nearest integer. The variable *High20* is motivated by an SEC requirement that the final offer price cannot be more than 20% above the final high file price.[11] A higher price requires a file range amendment. Thus, conditional on an existing file range, the distribution of possible offer prices is truncated. If an IPO is priced at 20% above the final file range, there is the possibility that a higher price was sustainable, but the firm and its underwriters elected to go forward with the offer rather than refile. Such offers may be particularly underpriced. A range of offer prices allows for the possibility that the offer price was rounded down to the nearest permitted integer. To our knowledge, this variable has not been considered in previous studies.

Table 2 presents the regression results. The first sample includes all offerings from 1981–2000 (4,977 observations). For the three subsamples, the numbers of observations are 1,554 (1981–1990), 2,577 (1991–1998), and 723 for the 1999–2000 subsample.[12]

The first regression of Table 2 shows that the variable of interest, *Integer*, is statistically significant with a coefficient of 0.027. *Integer* is also significant (at the 5% level) in each of the subsamples. Across the first two subsamples, integer offerings are more underpriced by 2.2 percentage points and 2.9 percentage points. In the 1999–2000 subsample, integer offerings are more underpriced by 20.6 percentage points.[13]

The overall sample regression has an adjusted R^2 of 50.8%. The adjusted R^2 is lower in the first two subsamples, 30.3% for 1981–1990 and 30.7% for 1991–1998, but it is 52.7% for the bubble period.

Turning to specific coefficients, the most consistently significant variable is *Above*. In every case, this variable's *t*-statistic exceeds 14, rising to 40 for the overall sample. The companion variable *Below* is also highly significant, but it is consistently smaller, providing clear evidence of an asymmetric response. *Overhang* is the next most significant variable in the overall sample; however, this variable is not significant in the 1981–1990 subsample. The variable *Secondary* is negative and significant in the overall sample, but it is insignificant in every subsample.

Examination of the Carter and Manaster (1990) ranks reveals a pattern that has attracted comment in numerous recent studies. In the 1981–1990 subsample, the evidence is consistent with the notion that high prestige banks are associated with lower underpricing. However, in the 1991–1998 and 1999–2000 subsamples, the pattern reverses.

[11] The rule is actually somewhat more complicated than this. As stated in Reg. §230.430A, a firm need not refile "if, in the aggregate, the changes in volume and price represent no more than a 20% change in the maximum aggregate offering price set forth in the 'Calculation of Registration Fee' table in the effective registration statement."

[12] *Lag IPO* is not available for 12 observations, dropping the total sample size from 4,989 to 4,977. Similarly, *High20* is not available for 122 of the observations in the 1991–1998 subsample and 1 observation in the 1999–2000 subsample, decreasing the sample sizes in these two subsamples. We excluded *Lag IPO* and *High20*, allowing the use of all 4,989 observations. *Integer* remains positive and significant with this new regression specification in the full sample and in each of the three subsamples (*p*-values = 0.0096, 0.0005, 0.0019, and 0.0534, respectively).

[13] We repeat the analysis using *t*-statistics constructed with White's (1980) heteroskedasticity consistent standard errors. *Integer* remains significantly positive at the 5% level in all four regressions.

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For the offer price range dummies, offers in the mid-price range are less underpriced than those in the low-price range in the overall sample and in the 1981–1990 and 1991–1998 subsamples. On the other hand, *High Offer Price* is insignificant in all four regressions indicating that high-priced offerings are just as underpriced as low-priced offerings.[14]

The cumulative return on the overall market in the period preceding the IPO is significantly positive in the overall sample and in the 1981–1990 and 1991–1998 subsamples, but not the bubble years. Recent underpricing in the IPO market is also positively related to underpricing in the overall sample and in the first two subsamples. Offer size is negative and significant overall and in the 1991–1998 subsample. VC backing is significantly negative in the 1991–1998 subsample, whereas high-tech orientation is associated with greater underpricing in the

TABLE 2

OLS Regression Results

Table 2 presents OLS regression results. The dependent variable is *Initial Return*, defined as the percentage change from the offer price to the closing stock price on the first day of trading less the contemporaneous CRSP value-weighted index return. All variables calculated as percentage changes (e.g., the initial return) are expressed as decimal numbers. The independent variables are:

Integer is a dummy variable equal to 1 if the offer price is on the integer, 0 otherwise.

Medium Offer Price is a dummy variable equal to 1 if the offer price is between $10 and $14.99, 0 otherwise.

High Offer Price is a dummy variable equal to 1 if the offer price is $15 or above, 0 otherwise.

Above is equal to the percent difference between the offer price and the midpoint of the original filing range if the offer price is greater than the original high file price, 0 otherwise.

Within is equal to the percent difference between the offer price and the midpoint of the original filing range if the offer price is within the original filing range, 0 otherwise.

Below is equal to the percent difference between the offer price and the midpoint of the original filing range if the offer price is less than the original low file price, 0 otherwise.

CM9, *CM8*, *CM67* are dummy variables equal to 1 if the Carter and Manaster (1990) ranking, as updated by Carter, Dark, and Singh (1998) and Loughran and Ritter (2003), is equal to 9, between 8 and 8.9, or between 6 and 7.9, respectively, 0 otherwise.

Overhang is measured as shares retained by existing stockholders divided by shares sold in the IPO.

Secondary is a dummy variable equal to 1 if the IPO includes shares sold by existing stockholders, 0 otherwise.

Lag Market is the compounded market return for the 21 trading days (i.e., one month) prior to the IPO date using the CRSP value-weighted index as a proxy for the market.

Lag IPO is the average market-adjusted IPO initial return for all sample IPOs for the month prior to the IPO date.

Log Size is the natural log of the CPI-adjusted, 1982–1984 = 100, total proceeds of the IPO in millions (excluding proceeds from the exercise of the over-allotment option).

Venture is a dummy variable equal to 1 if the IPO firm is venture capital-backed, 0 otherwise.

Tech is a dummy variable equal to 1 if the IPO firm is in a high-tech industry, 0 otherwise.

Multiple Class is a dummy variable equal to 1 if the IPO firm has multiple classes of stock, 0 otherwise.

Volatility is the standard deviation of the market-adjusted daily stock returns for the 63-trading day period from the seventh day of trading to the 69th day of trading (i.e., a three-month period). The CRSP value-weighted index return is used as a proxy for the market return.

NYSE/AMEX is a dummy variable equal to 1 if the firm is listed on the NYSE or AMEX after the IPO, 0 otherwise.

High20 is a dummy variable equal to 1 if the offer price is in the range from 20% above the high end of the amended file range down to the nearest integer, 0 otherwise. Data are generally not available for the 1981–1990 sample.

(continued on next page)

[14]Motivated by Figure 2, we replaced *Medium Offer Price* and *High Offer Price* in our regressions with two similarly constructed variables based on the filing range midpoint. *Medium File Price* is significantly negative in the 1981–1990 subsample and significantly positive in the 1999–2000 subsample. *High File Price* is positively related to the initial return in the 1999–2000 subsample, but insignificant in the other subsamples. *Integer* remains significantly positive at the 10% level or better in all four regressions.

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TABLE 2 (continued)
OLS Regression Results

Variable	Coefficient (*p*-value) Full Sample	1981–1990	1991–1998	1999–2000
Intercept	−0.0386 (0.2898)	0.0560*** (0.0040)	−0.0307 (0.3176)	−0.1500 (0.3962)
Integer	0.0271** (0.0119)	0.0224*** (0.0006)	0.0290*** (0.0055)	0.2062** (0.0471)
Medium Offer Price	−0.0488*** (0.0002)	−0.0139* (0.0860)	−0.0330** (0.0150)	−0.1248 (0.1488)
High Offer Price	−0.0287 (0.1237)	−0.0124 (0.3238)	−0.0132 (0.4914)	0.0600 (0.5590)
Above	1.2947*** (0.0001)	0.6677*** (0.0001)	0.6605*** (0.0001)	1.5336*** (0.0001)
Within	0.6548*** (0.0001)	0.4711*** (0.0001)	0.7482*** (0.0001)	0.6783 (0.2182)
Below	0.3318*** (0.0001)	0.2110*** (0.0001)	0.3171*** (0.0001)	0.5640** (0.0280)
CM67	0.0193 (0.2065)	−0.0277*** (0.0037)	0.0239 (0.1157)	0.0456 (0.6894)
CM8	−0.0014 (0.9288)	−0.0489*** (0.0001)	0.0304* (0.0505)	0.0263 (0.8112)
CM9	0.0579*** (0.0015)	−0.0458*** (0.0002)	0.0687*** (0.0002)	0.1444 (0.1895)
Overhang	0.0245*** (0.0001)	0.0015 (0.4220)	0.0153*** (0.0001)	0.0617*** (0.0001)
Secondary	−0.0278*** (0.0039)	−0.0046 (0.4825)	0.0031 (0.7332)	−0.0016 (0.9815)
Lag Market	0.5746*** (0.0001)	0.4275*** (0.0001)	0.7787*** (0.0001)	0.7229 (0.1754)
Lag IPO	0.1447*** (0.0001)	0.1616*** (0.0026)	0.2802*** (0.0001)	0.0884 (0.2384)
Log Size	−0.0165* (0.0545)	−0.0058 (0.3037)	−0.0205** (0.0219)	−0.0420 (0.3408)
Venture	−0.0032 (0.7595)	−0.0063 (0.4029)	−0.0231** (0.0197)	0.0937 (0.1104)
Tech	0.0046 (0.6616)	0.0160** (0.0496)	0.0113 (0.2633)	0.1215** (0.0207)
Multiple Class	−0.0320 (0.1083)	−0.0102 (0.5500)	−0.0063 (0.7180)	−0.1510 (0.1746)
Volatility	1.9671*** (0.0001)	0.6051** (0.0212)	2.0121*** (0.0001)	0.3494 (0.7487)
NYSE/AMEX	−0.0223 (0.1851)	0.0048 (0.6723)	−0.0140 (0.3713)	−0.0614 (0.5882)
High20	NA	NA	0.0579** (0.0421)	−0.0234 (0.7960)
Obs.	4,977	1,554	2,577	723
Adj. R^2	50.8%	30.3%	30.7%	52.7%

Year of offering dummy variables are included, but not reported. *p*-values are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is indicated with *, **, and ***, respectively. IPO data are collected from Thomson Financial's Securities Data Company (SDC) New Issues database and from CRSP for 4,989 offerings from January 1, 1981 to December 31, 2000.

1981–1990 and 1999–2000 subsamples. Dual-class capital structure is consistently negative, but not significant. Aftermarket volatility is positive and significant in the overall sample and in the 1981–1990 and 1991–1998 subsamples. Whether a firm trades on the NYSE or AMEX appears to be unrelated to the initial return. *High20* is positive and significant in the 1991–1998 subsample. The coefficient is economically large, 0.058, suggesting that these issues are indeed

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severely underpriced even after accounting for the upward revision in the offer price using *Above*.

The fact that several variables in our analyses have inconsistent effects is in agreement with Ritter and Welch's (2002) observation that many IPO phenomena are not stationary. In fact, our results show that only two variables have consistent effects across all three of the subsamples: the focus of our study (*Integer*) and the partial adjustment phenomenon (*Above*, *Below*). Thus, for the two decades covered by our sample, there is relatively strong and consistent evidence that integer offerings are more underpriced than fractional offerings, even after allowing for a wide variety of both stationary and non-stationary effects.

IV. The Negotiation Hypothesis

In this section, we consider an explanation for our results based on the costly negotiation hypothesis of Harris (1991). In Harris's model, buyers and sellers negotiate from a set of rounded stock prices to reduce the time needed to settle on a transaction price. Harris argues that the use of rounded vs. precise prices depends on two factors: the level of the stock price and the uncertainty surrounding the price. The reasoning for the first factor is intuitive. Assuming investors view the precision of the price set in relative terms, it is likely that the interval between prices in the price set will increase with the stock price (e.g., a \$0.125 interval for a \$15 stock and a \$0.25 interval for a \$30 stock).

Lower uncertainty concerning valuation should also cause buyers and sellers to use more precise prices in their negotiations. If both buyers and sellers have a precise estimate of the stock's value, the likelihood that they will both agree to transact on a rounded price is diminished. Negotiation from a coarse (fine) set of prices will naturally result in a coarse (fine) set of transaction prices.[15]

With IPOs, the final offer price is the result of negotiations between the issuing firm and the lead underwriter. The parties typically agree on the IPO's final offer price less than one day before the IPO date. After several weeks (or months) spent on road shows assessing investor demand, it is likely that both parties enter this pricing meeting with an estimate of the initial aftermarket price and also an assessment of the uncertainty about that price; however, there is little time left, so they must establish an offer price quickly.

As in Harris's model, we predict that the likelihood of the issuing firm and underwriter negotiating from a coarse or fine set of possible offer prices depends on their beliefs regarding the price in the aftermarket and degree of uncertainty about that price. Holding uncertainty constant, a higher price should result in the use of a coarser negotiation set. Thus, the frequency of rounded offer prices should be increasing in offer price.

Holding price constant, higher uncertainty regarding valuation should cause two effects to occur. According to the negotiation hypothesis, greater uncertainty

[15]Evidence supportive of Harris's (1991) negotiation hypothesis has been found in other markets. For instance, Cooney, Van Ness, and Van Ness (2003) show that clustering of SuperDOT limit orders on rounded numbers is a positive function of price and uncertainty. Sopranzetti and Datar (2002) find that the tendency of foreign exchange spot rates to cluster on "zeros" and "fives" increases with volatility.

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should give rise to a coarser set of possible offer prices. In addition, greater uncertainty should increase the extent of underpricing as the investment bank seeks to manage its underwriting risk. Therefore, the negotiation hypothesis predicts that integer offer prices will be more common as the valuation uncertainty increases. With greater uncertainty, whole dollar offer prices should also have more underpricing.

Mola and Loughran (2004) present evidence consistent with the negotiation hypothesis in their study of offer price discounts for U.S. seasoned equity offerings (SEOs). They document that SEOs with integer offer prices have higher discounts, on average, than SEOs with fractional offer prices. They show that from 1986–1999, there has been i) an increase in the riskiness of firms selling new equity, ii) an increase in the percentage of SEOs using integer offer prices, and iii) an increase in the average offer price discount. They also show that the probability of an integer offer price more than $1 below the current market price (e.g., an offer price of $13 for a stock trading at $14.25) is positively related to various risk proxies and the price level. Thus, Mola and Loughran's results are consistent with the predictions of the negotiation hypothesis: higher risk and higher price levels for SEO firms result in more rounded offer prices. In a related study of SEO discounts, Corwin (2003) indicates that both the desire to reduce negotiating costs and uncertainty over the underlying security's value contribute to rounding in SEO pricing.[16] Even though the two effects—integer price clustering on the IPO and SEO markets—are obviously related, the role of uncertainty should play a larger part in the pricing of IPOs than SEOs since, among other things, no trading history for IPOs exists.

A. Univariate Tests of the Negotiation Hypothesis

We calculate the percentage of whole dollar offer prices for subsamples sorted on the offer price and present the results in Table 3. As before, we define low-priced offerings as those priced between $5 and $9.99, medium-priced offerings are priced between $10 and $14.99, and high-priced offerings are priced at $15 and above.

Consistent with the negotiation hypothesis, the percentage of integer prices is lowest for low-priced offerings (1,014 out of 1,547 offerings, or 65.5%). For medium-priced offerings, 1,636 of 2,152 (76.0%) are whole dollar offerings, rising to 1,107 of 1,290 (85.8%) for high-priced offerings.

To proxy for uncertainty, we first measure the cross-sectional standard deviation of initial returns for samples of whole dollar and fractional IPOs. For integer offerings, this standard deviation is 29.1% for low-priced offerings, rising to 31.8% and 72.9%, respectively, for medium- and high-priced offerings. For fractional offerings, the cross-sectional standard deviations remain relatively constant (and significantly smaller compared to the integer offerings at the 0.01% level) across the offer price zones at 14.8%, 11.8%, and 12.4%, respectively.

[16] In addition to increasing risk levels, results in Corwin (2003) and Mola and Loughran (2004) suggest that other factors, such as changes in underwriter-firm relationships and the economics of investment banking, have led to increasing discounts in the SEO markets.

TABLE 3

Frequency of Integer Offerings and Standard Deviations of Initial and Aftermarket Returns, by Offer Price

	All Obs.	Offer Price: Low ($5–$9.99)	Medium ($10–$14.99)	High ($15 and above)
Panel A. Frequency of Integer and Non-Integer Offerings				
Integer	3,757	1,014	1,636	1,107
Non-Integer	1,232	533	516	183
Percent Integer	75.3%	65.5%	76.0%	85.8%
Panel B. Standard Deviation of Initial Returns				
Integer	49.7%	29.1%	31.8%	72.9%
Non-Integer	13.3%	14.8%	11.8%	12.4%
Diff.	36.4%	14.3%	20.0%	60.6%
p-Value for Diff. of Std. Dev.	0.0001	0.0001	0.0001	0.0001
Panel C. Volatility				
Integer	4.4%	4.5%	4.2%	4.5%
Non-Integer	3.4%	3.8%	3.1%	2.7%
Diff.	1.0%	0.6%	1.1%	1.8%
p-Value for Diff. of Means	0.0001	0.0001	0.0001	0.0001

Table 3 presents the frequency of integer offerings (panel A), the cross-sectional standard deviation of *Initial Return* (panel B), and *Volatility* (panel C) for IPOs with low, medium, and high offer prices. *Initial Return* is the percentage change from the offer price to the closing stock price on the first day of trading less the contemporaneous CRSP value-weighted index return. *Volatility* is the standard deviation of the market-adjusted daily stock returns for the 63-trading day period from the seventh day of trading to the 69th day of trading (i.e., a three-month period). The CRSP value-weighted index return is used as a proxy for the market return. The *p*-values for the tests of equality of means assume equal or unequal variances based on the outcome of a test of equality of variances. IPO data are collected from Thomson Financial's Securities Data Company (SDC) New Issues database and from CRSP for 4,989 offerings from January 1, 1981 to December 31, 2000.

These results suggest that whole dollar IPOs have greater valuation uncertainty than fractional IPOs, and the difference in uncertainty increases in offer price.

Although the cross-sectional standard deviation of initial returns is lower for fractional offerings, this pattern might be related to the overall lower initial return for fractional offerings rather than lower levels of uncertainty.[17] We therefore examine a second proxy for uncertainty, the ex post standard deviation of daily stock returns for a three-month period, beginning on the seventh day of trading (i.e., the previously defined variable *Volatility*). This measure of uncertainty has the advantage that it does not include the initial return or the first few trading days, but it too has a potential drawback. Post IPO volatility reflects both divergence of opinion regarding valuation and also the impact of changes in information structures.

Nonetheless, consistent with our first measure, the mean *Volatility* is significantly higher for whole dollar IPOs than for fractional IPOs, and the differences increase in offer price. For whole dollar IPOs, the mean *Volatility* is 4.5%, 4.2%, and 4.5%, for low-, medium-, and high-priced IPOs, respectively. For fractional IPOs, the means for the three offer price zones are 3.8%, 3.1%, and 2.7%, re-

[17] Assume that underwriters support the stock at, or just below, the offer price. This support effectively truncates the lower tail of the distribution of initial returns at (or around) 0% and could, therefore, reduce the empirically observed cross-sectional standard deviation in comparison to an environment where stock prices are not supported. With a lower mean initial return, standard deviations for the sample of fractional offerings are more likely to be biased by price support activities than integer offerings.

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spectively. In each price range, the means are statistically different at the 0.01% level.[18]

In summary, as predicted by the negotiation hypothesis, the proportion of whole dollar IPOs increases in the offer price. In addition, the uncertainty for the whole dollar sample is significantly higher than for the fractional sample, and the difference in uncertainty between the two samples increases with offer price.

B. Integer vs. Fractional File Prices

As a further test of the negotiation hypothesis, we examine IPO file prices. Early in the IPO process, the investment bank files the estimated price range with the SEC. This file range represents the investment bank's "bona fide" estimate of the minimum and maximum prices (SEC Regulation S-K Item 501(b)(3)). As we have previously suggested, IPOs with fractional offer prices may represent more precise valuations regarding the aftermarket price relative to their integer counterparts. Extending this hypothesis to the original filing range, we predict IPOs with integer file prices will have greater valuation uncertainty. That is, if the investment bank sets a filing range on the whole dollar (e.g., \$10.00–\$12.00), this signals that it has less certainty about firm value than if it sets a fractional filing range (e.g., \$10.50–\$12.50). With greater uncertainty, IPOs with integer file prices should be more underpriced than those with fractional file prices.

We start our analysis by calculating the mean initial return for IPOs with integer file prices (i.e., both the high and low original file price is at the whole dollar) and those with fractional file prices (i.e., either the high or low, or both, are set at the fraction of a dollar). Results are presented in the first column of numbers in Table 4. The mean initial return for IPOs with integer file prices is 22.4% vs. 8.7% for IPOs with fractional file prices (significantly different at the 0.01% level).

Consistent with the negotiation hypothesis, IPOs with integer file prices are more common for high file ranges. 71.7% of IPOs have integer file prices when the midpoint of the filing range is between \$5 and \$9.99. This percentage increases to 88.8% and 93.4%, respectively, for IPOs with a filing range midpoint between \$10 and \$14.99, and \$15 and above.

Also consistent with the negotiation hypothesis, IPOs with integer file prices have greater uncertainty. That is, IPOs with integer file prices have a statistically greater (at the 0.01% level) cross-sectional standard deviation of initial returns (47.1% vs. 14.7%, respectively) and mean ex post standard deviation of daily stock returns (4.3% vs. 3.3%, respectively).

Examining the pre-offer period allows for a third measure of uncertainty related to the percentage revision in the offer price. If fractional file prices signal low uncertainty about aftermarket value, then, on average, these offerings should have offer prices that are closer to the midpoint of the original filing range. As defined earlier, *Partial* is the percentage change in the final offer price relative to the original mid-file price. Thus, the cross-sectional standard deviation of *Partial*

[18] When the 1999–2000 subsample is excluded from the sample, the differences in cross-sectional standard deviations of initial returns and standard deviations of ex post stock returns between integer and non-integer IPOs are smaller in magnitude, but still statistically significant at the 0.01% level.

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TABLE 4

Interaction of File Prices and Offer Prices

	All Offerings	Offer Price		*p*-Values
		Integer	Fractional	
Integer File Prices				
Initial Return	22.4%	25.8%	8.8%	0.0001
N	4,283	3,414	869	
Risk Measures:				
Std. Initial Return	47.1%	51.7%	14.0%	0.0001
Volatility	4.3%	4.5%	3.5%	0.0001
Std. Partial	23.8%	25.2%	16.1%	0.0001
Fractional File Prices				
Initial Return	8.7%	11.2%	6.3%	0.0001
N	706	343	363	
Risk Measures:				
Std. Initial Return	14.7%	17.3%	11.4%	0.0001
Volatility	3.3%	3.5%	3.2%	0.0094
Std. Partial	15.2%	18.0%	12.0%	0.0001
p-Values				
Initial Return	0.0001	0.0001	0.0009	0.0001
Risk Measures:				
Std. Initial Return	0.0001	0.0001	0.0001	0.0001
Volatility	0.0001	0.0001	0.0081	0.0001
Std. Partial	0.0001	0.0001	0.0001	0.0001

Table 4 presents the interaction of file prices and offer prices. *Initial Return* is the percentage change from the offer price to the closing stock price on the first day of trading less the contemporaneous CRSP value-weighted index return. *Std. Initial Return* is the cross-sectional standard deviation of *Initial Return*. *Volatility* is the standard deviation of the market-adjusted daily stock returns for the 63-trading day period from the seventh day of trading to the 69th day of trading (i.e., a three-month period). The CRSP value-weighted index return is used as a proxy for the market return. *Std. Partial* is the cross-sectional standard deviation of *Partial* (the percentage difference between the offer price and midpoint of the original file range). *p*-values along the bottom row of numbers are for a test of equality of means (*Initial Return*, *Volatility*) and equality of variances (*Std. Initial Return*, *Std. Partial*) for IPOs with integer vs. fractional file prices. IPOs have integer file prices if both the high and low original file prices are set at the whole dollar. All other IPOs have fractional file prices. *p*-values along the last column of numbers are for a test of equality of means (*Initial Return*, *Volatility*) and equality of variances (*Std. Initial Return*, *Std. Partial*) for IPOs with integer vs. fractional offer prices. *p*-values in the bottom right-hand cell are for a test of equality of means (*Initial Return*, *Volatility*) and equality of variances (*Std. Initial Return*, *Std. Partial*) for IPOs with integer file and offer prices vs. IPOs with fractional file and offer prices. The *p*-values for the tests of equality of means assume equal or unequal variances based on the outcome of a test of equality of variances. IPO data are collected from Thomson Financial's Securities Data Company (SDC) New Issues database and from CRSP for 4,989 offerings from January 1, 1981 to December 31, 2000.

should be higher with the integer file price sample. As predicted, we find that the standard deviation of *Partial* is much higher for IPOs with integer file prices (23.8%) than for IPOs with fractional file prices (15.2%).

Table 4 also shows the interaction of integer vs. fractional file and offer prices in a two-by-two framework. In essence, the filing of the original price range and the setting of the final offer price can be viewed as two observations that signal, to at least some degree, the relative uncertainty surrounding the valuation of the IPO. Issues with integer file and integer offer prices (the top cell in the second column of numbers) should be the most uncertain and most underpriced. Conversely, IPOs with fractional file and fractional offer prices (the bottom cell in the third column of numbers) should be the least uncertain and least underpriced.

Consistent with this hypothesis, we find that IPOs with integer file and offer prices are the most underpriced (25.8%), and IPOs with fractional file and offer prices are the least underpriced (6.3%). Valuation uncertainty, as measured by all three risk proxies, is lowest for the IPOs with fractional file and offer prices. Further, issues with a fractional file range and integer offer price (and vice versa) have much lower initial returns than IPOs with integer file and integer offer prices.

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This result is consistent with the notion that a fractional price at either stage signals less uncertainty regarding valuation.[19]

C. The Integer Effect and the Partial Adjustment Phenomenon

As we previously noted, Figure 2 suggests that the partial adjustment phenomenon may be less pronounced for IPOs with fractional offer prices. As it is usually interpreted, the partial adjustment phenomenon should be a monotonic effect. That is, if two offerings have the same filing range, then the one with the higher final offer price should have greater underpricing, all else the same. However, as we show next, this is not the case.

Table 5 presents results for the 572 offerings with a price range of \$10–\$12, the most common range in our sample. As shown, a "zigzag" pattern exists for offerings priced at the low file price or higher. The pattern is particularly strong for offerings priced at or above the \$12 high. For example, issues priced at the high have an average initial return of 20.3% compared to 12.0% for those priced on the fraction immediately above the high (\$12.01–\$12.99).

TABLE 5

Integer vs. Fractional IPOs and the Partial Adjustment Phenomenon

Offer Price	*Mean Initial Return*	*Std. Initial Return*	*Volatility*	Obs.
Less than \$9—Integer	7.5%	21.8%	5.3%	70
Less than \$9—Fraction	4.3%	5.6%	4.1%	30
\$9.00	2.2%	5.6%	3.8%	35
\$9.01–\$9.99	7.3%	8.0%	4.0%	11
\$10.00	9.5%	19.4%	4.3%	62
\$10.01–\$10.99	5.8%	8.9%	3.8%	27
\$11.00	11.9%	16.3%	4.5%	59
\$11.01–\$11.99	9.2%	10.6%	3.5%	28
\$12.00	20.3%	17.7%	5.2%	89
\$12.01–\$12.99	12.0%	9.6%	3.0%	13
\$13.00	38.9%	31.5%	5.4%	42
More than \$13—Fraction	22.2%	15.4%	3.3%	9
More than \$13—Integer	86.1%	71.5%	6.2%	97
Integer	30.1%	48.3%	5.1%	454
Fraction	8.3%	10.2%	3.7%	118
p-Value for Diff. of Means	0.0001	0.0001	0.0001	

Table 5 presents information for integer and fractional IPOs based on the relation between the original filing range and the offer price. The sample examined consists of 572 IPOs with a \$10 low and \$12 high file price range. File prices are the original estimated price range filed with the SEC. *Initial Return* is the percentage change from the offer price to the closing stock price on the first day of trading less the contemporaneous CRSP value-weighted index return. *Std. Initial Return* is the cross-sectional standard deviation of *Initial Return*. *Volatility* is the standard deviation of the market-adjusted daily stock returns for the 63-trading day period from the seventh day of trading to the 69th day of trading (i.e., a three-month period). The CRSP value-weighted index return is used as a proxy for the market return. *p*-values along the bottom row of numbers test equality of means (*Initial Return*, *Volatility*) and equality of variances (*Std. Initial Return*) for IPOs with integer vs. fractional offer prices. The *p*-values for the tests of equality of means assume equal or unequal variances based on the outcome of a test of equality of variances. IPO data are collected from Thomson Financial's Securities Data Company (SDC) New Issues database and from CRSP for 4,989 offerings from January 1, 1981 to December 31, 2000.

Table 5 also reports two of our three measures of uncertainty—the cross-sectional standard deviation of *Initial Return* and *Volatility* (the third measure, the cross-sectional standard deviation of *Partial*, is not meaningful because the sample is sorted by the adjustment in offer price). Consistent with our predictions,

[19]We find that the magnitude of the differences in initial returns and proxies for uncertainty for the integer and non-integer samples are smaller when the 1999–2000 subsample is excluded from the sample. However, these differences remain statistically significant at the 5% level or better.

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fractional offerings have less uncertainty than integer offerings. For example, for the sample of IPOs priced at \$11, the standard deviation of *Initial Return* is 16.3%, but it is only 10.6% for offerings priced between \$11.01 and \$11.99. The mean *Volatility* is 4.5% for offerings priced at \$11, but only 3.5% for offerings priced between \$11.01 and \$11.99. Similar conclusions can be drawn from other IPOs priced on the integer vs. the next higher fraction.[20]

The Benveniste and Spindt (1989) model is a well-known explanation for the partial adjustment effect. In their model, investment banks induce investors to reveal their private information about firm value through the allocation of IPO shares and the setting of the offer price. Investors with good information about the issuing firm reveal their high valuations to receive a greater share allocation. Investment banks ensure that this greater allocation is valuable by partially adjusting the offer price to the positive information. Thus, a positive relation obtains between the offer price revision and underpricing. Hanley (1993) and others provide empirical evidence documenting such a relation.

At first glance, the evidence in Table 5 appears to suggest an important qualification to evidence regarding the partial adjustment phenomenon. Although the Benveniste and Spindt (1989) model predicts that IPOs with greater offer price revisions will be more underpriced, we show that movement from an integer offer price to a higher fractional offer price can actually decrease underpricing.

Figure 3 sheds some light on this issue by comparing underpricing for integer and non-integer IPOs based on whether the final offer price is below, within, or above the original filing range. There is a clear partial adjustment effect for both groups, but it is much more pronounced for the integer group. For instance, although the average underpricing for integer and non-integer IPOs is approximately the same for below-range offerings, integer issues priced above the file range are underpriced, on average, by 64.3% compared to 19.8% for non-integer issues. If we omit the 1999–2000 subsample, the corresponding numbers are 34.9% vs. 19.9%, so the difference is still quite pronounced.

The pattern shown in Figure 3 is actually consistent with the Benveniste and Spindt (1989) model if there is less uncertainty surrounding the aftermarket value of the non-integer IPOs. First, if investment banks and their investors have relatively precise valuations, then, once again, the negotiation hypothesis predicts that more fractional prices will be observed. Second, if the investment bank has a relatively precise valuation, then the additional information gained in the book-building process is less valuable, and the corresponding underpricing needed to compensate suppliers of information will be smaller.

[20]The zigzag pattern in Table 5 is less pronounced when the 1999–2000 subsample is omitted, and it is primarily observed for offerings priced at or above the high file price of \$12. In unreported results, we analyze all offerings with integer file prices and a \$2 price range. The 3,386 observations meeting these criteria represent about two-thirds of our sample. The results are similar to those presented in Table 5. As with the \$10–\$12 file range sample, the zigzag pattern with this larger sample becomes less pronounced when the bubble period is excluded, but it is still observed for offerings priced at or above the high file price.

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FIGURE 3

Initial Returns by Filing Range: Integer vs. Non-Integer IPOs

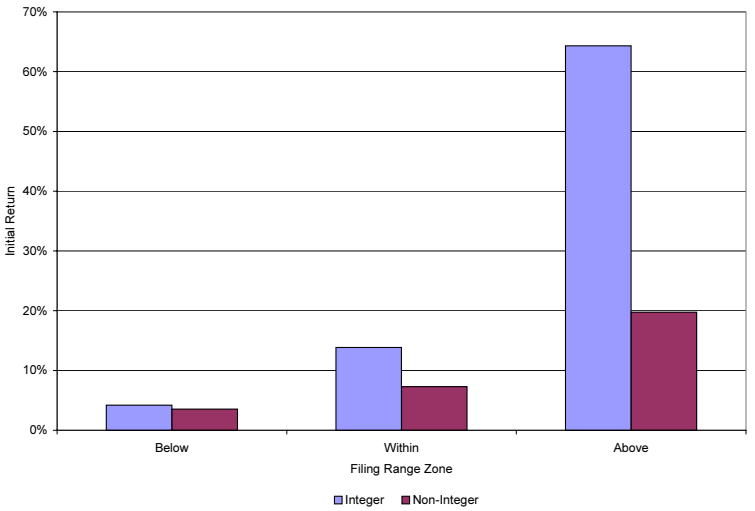


Figure 3 plots average initial returns for 4,989 IPOs priced on the integer and non-integer by whether the offering is priced below, within, or above the original filing range. IPO data are collected from Thomson Financial's Securities Data Company (SDC) New Issues database and from CRSP for offerings from January 1, 1981 to December 31, 2000.

D. Time Trends in Integer Offer Prices, Price Level, and Uncertainty

As documented in numerous studies, there has been a substantial increase in initial returns from the 1980s to the 1990s (e.g., Loughran and Ritter (2003), Ljungqvist and Wilhelm (2003)). Has there been a corresponding increase in integer pricing? Table 6 shows the frequency of integer IPOs, and means for *Initial Return*, *Offer Price*, and our three measures of uncertainty (*Std. Initial Return*, *Volatility*, and *Std. Partial*) for 1981–1990, 1991–1998, and 1999–2000.

Similar to other studies (and Figure 1), we observe substantial increases in initial returns across the three periods. Likewise, the frequency of integer prices has increased, rising from 61.9% of IPOs in 1981–1990 to 78.0% in 1991–1998. During the bubble period, 94.1% of offerings had whole dollar offer prices. The average offer price is $11.54 during the 1980s, slightly higher in 1991–1998 ($11.77), but almost $3 higher in the bubble period ($14.51). All three measures of uncertainty show economically and statistically significant increases over our sample period. Thus, as predicted, the growth in the frequency of integer offer prices is associated with increases in price level, uncertainty, and underpricing.[21] Table 6 also presents averages for initial returns, offer prices, and the three uncertainty measures for integer vs. fractional offerings across the three periods.

[21] Although an increase in the riskiness of IPOs is consistent with an increase in the observed underpricing across the decades, other forces, such as increased bargaining power for underwriters, might also contribute to the rise in underpricing. For instance, Loughran and Ritter (2003) argue that the rise in importance of analyst coverage by underwriters and the use of "side-payments" from underwriters to the issuing firm's decision makers have contributed to the increase in underpricing across the decades.

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TABLE 6

Frequency of Integer Offer Prices across the 1980s, 1990s, and Bubble Period

Sample	*N*	Percentage	*Initial Return*	*Offer Price*	*Std. Initial Return*	*Volatility*	*Std. Partial*
(1) 1981–1990	1560		7.71%	$11.54	14.21%	2.85%	15.72%
Integer	966	61.92%	8.89%	$11.71	15.70%	2.93%	16.87%
Fraction	594	38.08%	5.80%	$11.26	11.13%	2.73%	13.64%
p-Values			0.0001	0.0416	0.0001	0.0037	0.0001
(2) 1991–1998	2701		15.47%	$11.77	25.40%	3.99%	20.04%
Integer	2106	77.97%	16.88%	$11.98	27.55%	4.03%	21.01%
Fraction	595	23.03%	10.48%	$11.03	14.53%	3.86%	15.78%
p-Values			0.0001	0.0001	0.0001	0.0128	0.0001
(3) 1999–2000	728		66.12%	$14.51	89.84%	7.40%	35.75%
Integer	685	94.09%	69.91%	$14.59	91.20%	7.52%	36.15%
Fraction	43	5.91%	5.75%	$13.23	17.02%	5.43%	20.87%
p-Values			0.0001	0.1866	0.0001	0.0004	0.0001
(2)–(1)			7.76%	$0.23	11.19%	1.14%	4.32%
p-Values			0.0001	0.0893	0.0001	0.0001	0.0001
(3)–(2)			50.65%	$2.74	64.44%	3.41%	15.71%
p-Values			0.0001	0.0001	0.0001	0.0001	0.0001
(3)–(1)			58.41%	$2.97	75.63%	4.55%	20.03%
p-Values			0.0001	0.0001	0.0001	0.0001	0.0001

Table 6 presents the frequency of IPOs with integer and fractional offer prices by period (1981–1990, 1991–1998, and 1999–2000). For both IPO types, means for *Initial Return*, *Offer Price*, and *Volatility* are reported along with *Std. Initial Return* and *Std. Partial*. *Initial Return* is the percentage change from the offer price to the closing stock price on the first day of trading less the contemporaneous CRSP value-weighted index return. *Std. Initial Return* is the cross-sectional standard deviation of *Initial Return*. *Volatility* is the standard deviation of the market-adjusted daily stock returns for the 63-trading day period from the seventh day of trading to the 69th day of trading (i.e., a three-month period). The CRSP value-weighted index return is used as a proxy for the market return. *Std. Partial* is the cross-sectional standard deviation of *Partial* (the percentage difference between the offer price and midpoint of the original file range). The first three sets of *p*-values are for tests of equality of means (*Initial Return*, *Offer Price*, and *Volatility*) and equality of variances (*Std. Initial Return* and *Std. Partial*) for integer vs. fractional offerings. The second three sets of *p*-values are for tests of equality of means (*Initial Return*, *Offer Price*, and *Volatility*) and equality of variances (*Std. Initial Return* and *Std. Partial*) across the three periods. The *p*-values for the tests of equality of means assume equal or unequal variances based on the outcome of a test of equality of variances. IPO data are collected from Thomson Financial's Securities Data Company (SDC) New Issues database and from CRSP for 4,989 offerings from January 1, 1981 to December 31, 2000.

Again, higher initial returns, price levels, and uncertainty are observed for integer offerings. A formal test of the negotiation hypothesis is presented next.

E. Logistic Regression Results

In our final test of the negotiation hypothesis, we turn to a logistic regression. The dependent variable, *Integer*, takes on a value of 1 if the offer price is on the integer. The independent variables include dummies for medium- and high-priced offerings (*Medium Offer Price* and *High Offer Price*) and our ex post measure of uncertainty (*Volatility*). According to the negotiation hypothesis, *Integer* should be positively related to these variables. As controls, we include the partial adjustment variables (*Above*, *Within*, and *Below*), the Carter and Manaster (1990) dummy variables (*CM9*, *CM8*, *CM67*), the log of the CPI-adjusted total proceeds of the offering (*Log Size*), and year of offering dummies (not reported in the tables). The Carter and Manaster ranks and *Log Size* may serve as proxies for the bargaining power of the underwriter and issuing firm. The partial adjustment variables are included to account for the possibility that the bargaining power of the two parties varies depending on whether the offer price has been revised up or down. The partial adjustment variables can also serve as a measure of valuation uncertainty. That is, IPOs ultimately priced close to the filing range midpoint probably have less uncertainty than IPOs priced away from the mid-

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point. Thus, the negotiation hypothesis predicts that integer offerings should be more frequently observed for IPOs priced significantly above or below the filing range midpoint.

Logistic regression results appear in Table 7. As with our previous set of regressions, we present results for the full sample and for the 1981–1990, 1991–1998, and 1999–2000 subsamples. As predicted, there is a positive relation be-

TABLE 7

Logistic Regression Results

Table 7 presents logistic regression results. The dependent variable is binary, taking a value of 1 if the IPO is priced on the integer, 0 otherwise. The independent variables are:

Medium Offer Price is a dummy variable equal to 1 if offer price is between $10 and $14.99, 0 otherwise.

High Offer Price is a dummy variable equal to 1 if offer price is $15 or above, 0 otherwise.

Volatility is the standard deviation of the market-adjusted daily stock returns for the 63-trading day period from the seventh day of trading to the 69th day of trading (i.e., a three-month period). The CRSP value-weighted index return is used as a proxy for the market return.

Above is equal to the percent difference between the offer price and the midpoint of the original filing range if the offer price is greater than the original high file price, 0 otherwise.

Within is equal to the percent difference between the offer price and the midpoint of the original filing range if the offer price is within the original filing range, 0 otherwise.

Below is equal to the percent difference between the offer price and the midpoint of the original filing range if the offer price is less than the original low file price, 0 otherwise.

CM9, *CM8*, *CM67* are dummy variables that take on the value of 1 if the Carter and Manaster (1990) ranking, as updated by Carter, Dark, and Singh (1998) and Loughran and Ritter (2003), is equal to 9, between 8 and 8.9, or between 6 and 7.9, respectively, 0 otherwise.

Log Size is the natural log of the CPI-adjusted, 1982–1984 = 100, total proceeds of the IPO in millions (excluding proceeds from the exercise of the over-allotment option).

All variables calculated as percentage changes (e.g., *Above*) are expressed as decimal numbers. Each regression includes year of offering dummy variables (not reported). Statistical significance at the 10%, 5%, and 1% levels is indicated with a *, **, and ***, respectively. IPO data are collected from Thomson Financial's Securities Data Company (SDC) New Issues database and from CRSP for 4,989 offerings from January 1, 1981 to December 31, 2000.

	Coefficient (*p*-value)			
Variable	Full Sample	1981–1990	1991–1998	1999–2000
Intercept	−0.1699 (0.4997)	0.2340 (0.4624)	0.2703 (0.3963)	−0.4385 (0.5945)
Medium Offer Price	0.7444*** (0.0001)	0.7388*** (0.0001)	0.6262*** (0.0001)	1.7577*** (0.0005)
High Offer Price	1.4101*** (0.0001)	1.5559*** (0.0001)	1.3231*** (0.0001)	1.4925** (0.0232)
Volatility	15.5846*** (0.0001)	14.4047*** (0.0030)	11.3721*** (0.0025)	33.7247*** (0.0001)
Above	1.4247*** (0.0007)	1.0044 (0.2450)	1.2941** (0.0158)	2.3527* (0.0958)
Within	0.6370 (0.3463)	−0.0380 (0.9686)	0.6250 (0.5331)	5.4081 (0.1319)
Below	−1.5235*** (0.0001)	−2.4358*** (0.0001)	−1.0356** (0.0251)	−1.0600 (0.4709)
CM67	−0.0011 (0.9918)	−0.3309** (0.0478)	0.1880 (0.2298)	0.5674 (0.3849)
CM8	0.2177* (0.0608)	−0.0394 (0.8243)	0.3631** (0.0244)	0.5592 (0.3568)
CM9	0.0217 (0.8780)	−0.2063 (0.3488)	0.0705 (0.7207)	0.5994 (0.3240)
Log Size	−0.2518*** (0.0001)	−0.3608*** (0.0002)	−0.1943** (0.0411)	−0.2815 (0.2118)
N	4,989	1,560	2,701	728
p-Value of Likelihood Ratio	0.0001	0.0001	0.0001	0.0001

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tween the frequency of integer pricing and *Medium Offer Price* and *High Offer Price*. Also consistent with the negotiation hypothesis, a positive relation exists between the frequency of integer pricing and *Volatility*—IPOs with more uncertainty have more whole dollar prices. Analysis by subsample shows similar results to those presented for the entire sample period. *Medium Offer Price*, *High Offer Price*, and *Volatility* remain positive and significant (at the 5% level or better) in all three subsamples. The partial adjustment variable *Above* is positive and significant in the main regression and in the 1991–1998 and 1999–2000 subsamples. *Below* is negative and significant in the main regression and in the 1981–1990 and 1991–1998 subsamples. This suggests that the frequency of integer offerings is highest for offerings priced significantly away from (i.e., significantly above or below) the filing range midpoint, consistent with the notion that IPOs priced away from the filing range midpoint have greater uncertainty. *Log Size* is negative in all four regressions; it is significant in the first three. No consistent pattern is observed with the other control variables.[22]

Overall, the logistic regressions provide further support for the negotiation hypothesis. The likelihood of an integer price increases with both price and uncertainty.

V. Conclusion

We examine the pricing structure of 4,989 U.S. IPOs from 1981–2000. Seventy-five percent of these IPOs are priced on integers. The mean initial return for these whole dollar IPOs is 24.5% vs. 8.1% for non-integer offerings, a difference that is economically large and statistically significant at any conventional level. Our results are robust after conditioning for determinants typically used to model IPO initial returns. The effect persists in the 1980s, 1990s, and the "bubble" period of 1999 and 2000. The evidence strongly suggests that whether the offer price is an integer or non-integer conveys valuable information to market participants. We even find that firms with fractional file range prices are much less underpriced than firms with integer file ranges, so the information signaled is available long before the final offer price is set.

An explanation for our findings revolves around the negotiations that take place between the issuing firm and its underwriter in determining the final offer price. The negotiation hypothesis predicts more integer prices for high-priced IPOs and IPOs with a high degree of uncertainty concerning their aftermarket value. At the same time, with higher valuation uncertainty, whole dollar offerings should have greater underpricing.

Our results support the negotiation hypothesis. High-priced IPOs are much more frequently priced on the integer. Integer IPOs have greater variation in initial returns, greater post-offering return volatility, and greater cross-sectional

[22] As a robustness check, we include *Overhang*, *Secondary*, *Lag Market*, *Lag IPO*, *Venture*, *Tech*, *Multiple Class*, and *NYSE/AMEX* in our logistic regressions (and *High20* in the regressions covering the 1991–1998 and 1999–2000 subsamples). *Medium Offer Price*, *High Offer Price*, and *Volatility* remain positive and significant (at the 0.01%, 0.01%, and 0.04% levels, respectively) in the full sample. Although the level of significance drops in the three subsamples, *Medium Offer Price*, *High Offer Price*, and *Volatility* remain positive with the least significant *p*-value equal to 14.4% (*Volatility*, 1991–1998 subsample).

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variation in the final offering price relative to the initial mid-file price. Logistic regressions add further support to these findings.

We also examine the well-known partial adjustment phenomenon and show that integer IPOs are often more underpriced than IPOs set at the fraction immediately above. For example, integer IPOs set exactly at the high end of the filing range have, on average, a higher initial return than IPOs set at the fraction immediately above the high. Thus, contrary to what is normally predicted, initial returns do not necessarily monotonically increase with the offer price revision. We show that there actually is a consistent partial adjustment effect for both integer and non-integer IPOs when these offerings are analyzed separately, but the magnitude is much smaller for non-integer IPOs. Once again, this behavior is consistent with the negotiations hypothesis if non-integer IPOs can be more precisely valued than integer IPOs.

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