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# THE IPO EFFECT AND MEASUREMENT OF RISK

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## Abstract

Numerous empirical studies of the well documented IPO underpricing anomaly have employed a variety of different proxies for risk, none of which seem able to explain a significant portion of initial trading day returns. We find evidence that several of the risk proxies used in these studies are outperformed by the Parkinson Extreme Value method in explaining returns to IPOs; hence, these studies seem to have underestimated the explanatory power of uncertainty to predict IPO returns. Nonetheless, we do find evidence in support of the asymmetric information theories of IPO underpricing.

## INTRODUCTION AND LITERATURE REVIEW

The apparent underpricing of initial public offerings (IPOs) has drawn much attention in the recent financial literature. Empirical studies indicate that abnormally high offer date returns simply cannot be explained by security risk (e.g. McDonald and Fisher [1972] and Ibbotson [1975]). Furthermore, the various models of IPO pricing behavior (discussed below) do not seem to fully explain the behavior of IPO returns.

Measuring IPO pricing uncertainty is obviously more problematic than determining the risk of seasoned issues. Lack of price histories and published information both contribute to this difficulty. This paper is concerned with the comparison of the Parkinson Extreme Value method for risk measurement with other commonly used risk surrogates, particularly underwriter reputation and the inverse of gross proceeds. The results of this study indicate that the Parkinson measure does explain a significantly greater portion of IPO underpricing than do the other methods, suggesting that the other studies have underestimated the explanatory power of uncertainty to predict underpricing.

### Theories of Underpricing

One might expect that underwriters and issuers of IPOs along with each of the individual investors would have different sets of information regarding to the value of the issue. Many of the underpricing theories contend that underpricing is a form of compensation for the risk that a particular party bears because of an assumed informational advantage of one of the parties over another, and other theories propose underpricing is compensation for providing information to other participants.

Rock (1986) argues that underpricing is a result of the risk assumed by uninformed investors because of the informational advantage of informed investors. Beatty and Ritter (1986) extend Rock's model and find that underpricing is an increasing function of the ex-ante uncertainty of the issue. Carter and Manaster (1990) develop another extension of Rock's model demonstrating that as the risk of an issue increases, informed demand will increase, exacerbating the adverse selection problem and the required underpricing. Low risk firms can not creditably distinguish themselves from high risk firms. However, they can employ high reputation investment banks to certify that they are low risk firms, which allows them to underprice by less. Booth and Smith (1986) hypothesize that the underwriter stakes its reputational capital as a bond that securities' prices reflect all potential negative inside information about the expected performance of the firm. Underpricing provides both protection and compensation for the use of the underwriter's reputational capital. Tinic (1988) suggests that underpricing is a form of insurance to protect underwriters against potential due diligence legal liabilities. Greenblatt and Hwang (1989) claim that underpricing is a signal by a more informed issuer to indicate firm value and the variance of expected returns to less informed investors.[1]

Contrasting the above theories proposing that underpricing is related to private information that the firm has which is not available to investors, Benveniste and Spindt (1990) suggest that informed investors reveal their information to the

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underwriter by their orders before the offering price is set and that underpricing is compensation to informed investors for the information that they convey to the underwriter.

## Empirical Studies

McDonald and Fisher [1972], Ibbotson [1975] and Muscarella and Vetsuypens (1989) have all documented the existence of statistically significant underpricing if IPOs. Carter and Manaster (1990) provide empirical evidence that IPOs underwritten by high reputation investment banks have lower risk and returns than those by low reputation investment banks.[2] This result suggests that underwriter reputation might itself serve as a surrogate for IPO risk. Tinic provides empirical support for his "insurance" hypothesis by demonstrating underpricing to be largely a post-depression phenomena, when strict securities laws were passed.[3]

Some recent research provides additional support for asymmetric information hypotheses, although, the evidence does not distinguish the validity of one informational theory over another. Peavy (1990) examines 41 closed-end fund IPOs going public during 1986 and 1987 and finds that their returns are not significantly different from zero, contrasting to the overwhelming empirical evidence that nonfund IPOs are significantly underpriced. Clearly, the asymmetric information between the issuer, underwriter and investor for closed-end funds, which are typically portfolios of securities, is less than for nonfund IPOs. Weiss analyzed 67 closed end funds that went public between 1985 and 1987 and obtained results similar to those of Peavy.

Muscarella and Vetsuypens (1989) also found support for the asymmetric information theory. They argued that the information asymmetry should be significantly reduced for IPOs of companies that were once public, then taken private. Supporting the information hypothesis, they found that for the 74 firms in their sample that went public and then private, underpricing was significantly less than for other IPOs.

## Empirical Problem: Measuring Ex-Ante Risk

A crucial element concerning the measurement of abnormal IPO returns is the problem of ex-ante risk measurement. The measurement of ex-ante risk for IPOs is even more difficult because there is no historical price data to draw upon. The standard deviation of after-market returns has been frequently used as a proxy for ex-ante risk. By convention, the standard deviations of the first twenty days is used. However, this ex-ante risk surrogate has shown very little explanatory power, causing some earlier researchers to conclude that risk does not significantly influence returns. More recent studies (e.g: Johnson and Miller [1988]) conclude that the standard deviation of after-market returns is a poor measure of ex-ante risk; much of the current research makes use of entirely different risk proxies (e.g: Carter and Manaster [1990]).

Beatty and Ritter (1986) find evidence that risk does affect after-market returns. They use two different proxies for ex-ante risk, the first being the number of uses of proceeds listed in the new issue prospectus. The SEC requires issues that they deem to be more speculative to provide more detailed explanations of their expected uses for the proceeds from the offering. Hence, those issues with more detailed listings in their filings may be deemed more speculative. The second risk proxy used by Beatty and Ritter is the inverse of the gross proceeds for the given issue. Their justification for this proxy is the empirical regularity that smaller issues are generally more speculative than larger issues. Beatty and Ritter find that both the number of uses for the proceeds and the inverse of the gross proceeds are statistically significant explanatory variables of initial returns. However, the r-squared for their multivariate regression was only 0.07.

The age of the firm has been used as a risk proxy for several studies. One might expect that more established firms are less risky. The reputation of the underwriter has been used more frequently as a risk proxy (e.g: Carter and Manaster [1990] and Johnson and Miller [1988]). High reputation underwriters possessing more complete information than investors will normally underwrite the securities of low risk firms to avoid losing reputational capital. Each of the proxies for ex-ante risk discussed to this point have been demonstrated to be statistically significantly related to apparent underpricing. However, each proxy, whether considered individually or in combination provides very little explanatory power as measured by r-squared values.

Finally, Parkinson (1980) demonstrates that if the natural log of the stock price relative follows a normally distributed random walk, a factor proportionally related to the log of the high price during the period divided by the low price of the period serves as an excellent predictor of stock return standard deviation. We find that this extreme value method, the natural log of the ratio of the high and low price of the first day the IPO is traded in the after-market is a superior estimate of the variance of the rate of return over the estimation interval. In an earlier study, Barry and Jennings (1991) divided their sample between underpriced and overpriced issues and found the differences in risk using the Parkinson measure were not significant. However, the authors sample size was 229 and their results were based on a sample where first traded prices were available, omitting many IPOs which might be regarded as being more speculative.

## DATA AND VARIABLE SPECIFICATION

Our sample consists of 822 IPOs from 1986 through 1989 for firm commitment offerings listed in *Going Public: The IPO Reporter*. The data includes IPOs whose gross proceeds exceed $1 million and offering price is at least $1. In order to be included in the sample, the issue must not be a unit offering, and the closing, high and low stock price on the day the firm went public must be listed in the *Standard and Poor's Daily Stock Price Record* or be part of the Smith, Barney, Upham & Co. data base. The bulk of the data were provided by Smith, Barney, Upham & Co., a major underwriter of IPOs. Additional data were compiled from issues of the *Investment Dealers Digest*. For each IPO in our sample we have the following data:

1. the closing price on the first day of trading ($P_{1D}$),
2. the industry
3. the managing underwriter,
4. the gross proceeds (*GP*),
5. the offering price (*OP*),
6. the high price on the first day of trading (*H*), and
7. the low price on the first day of trading (*L*).

As a proxy for asymmetric information, we construct a dummy variable for each issue in the sample. The dummy variable (DUMCL) takes a value of one if the issue is a closed-end mutual fund and zero otherwise. There are 119 closed-end funds in the sample. As mentioned earlier, Peavy (1990) and others found evidence that closed-end funds were underpriced by less than non-fund IPOs. The studies claim this supports the asymmetric information models.

We calculate three proxies for risk. The first proxy for risk is Parkinson's Extreme Value measure, the natural log of H/L (LOGHL). The second proxy is the inverse of the gross proceeds (INVGP). The third proxy for risk is the prestige of the managing underwriter. In order to construct an underwriter prestige variable, we examine the locations of underwriters in tombstone advertisements carried in the *Wall Street Journal* and *Investment Dealers Digest*, between January 1986 to December 1988. Following Carter and Manaster (1990) who assign a point ranking from one to nine for each underwriter depending on its location in the ad, we assign point scores of one to four. We then total rank scores and divide underwriters into four groups. The reputational variable (REP) takes on values between one and four, where the most prestigious underwriters receive a rank of four. We believe that the smaller number of prestige classifications leads to more robust tests. Similarly, Carter and Manaster divided their sample into two groups for many of their tests.

The initial return on an IPO is defined as $R_{1D}$ and is calculated as:

$$R_{ID} = \frac{(P_{ID} - OP)}{OP}$$

In Table 1 some summary statistics for the IPOs in our sample are provided. Consistent with other studies, we find that initial returns for closed-end funds are not significantly different from zero. Also, closed-end funds on average have larger and financial institutions smaller gross proceeds than industrial IPOs. Closed-end funds have higher reputation underwriters, while they have a lower LOGHL than non-fund IPOs.

## EMPIRICAL TESTS AND RESULTS

In this section, we examine the explanatory power on underpricing of uncertainty due to asymmetric information and uncertainty not due to asymmetric information. We propose that LOGHL is a better proxy for uncertainty than other measures. The empirical evidence in this paper and others shows that underpricing for closed-end funds is not significantly different from zero. This has been attributed to less asymmetric information for closed-end funds. If our proxy for risk the LOGHL is valid, it should be significantly less for closed-end funds than for industrial firms or financial institutions. As reported in Table 1, the mean of the LOGHL for closed-end funds, financial institutions and industrial firms are 1.49%, 5.5% and 5.4%, respectively. The t-test for differences between closed-end fund LOGHL and LOGHL for financial institutions and industrial firms are -11.73 and -9.43, respectively, both of which are significant at the 1% level. However, there is no significant difference between industrial firm LOGHL and that of financial institutions.

In a second test, we compare the mean of LOGHL for under- and over-priced issues, which are 0.0561 and 0.0356, respectively. The t-test statistic is 6.21 which is significant at the 0.01 level.[4] As a further check of our proposition, we calculate a Spearman's rank correlation coefficient on the ordering of initial trading date returns and LOGHL. The

**TABLE 1**
**Summary Statistics for IPOs Categorized by Industry**

| | Closed-end Funds | Financial | Industrial | Entire Sample |
|---|---|---|---|---|
| Number of Issues | 113 | 92 | 583 | 788 |
| Mean Initial Return (%) | 0.13 | 4.76 | 5.36 | 4.54 |
| Standard Deviation (%) | 5.95 | 7.07 | 14.11 | 12.70 |
| T-test for Initial Return | 0.24 | 6.46** | 9.16** | 10.03** |
| Median Gross Proceeds (millions $) | 125.0 | 10.5 | 21 | 24.8 |
| Mean Gross Proceeds (millions $) | 270.39 | 24.41 | 48.98 | 77.86 |
| Mean log(H/L) (%) | 1.44 | 5.62 | 4.70 | 4.34 |
| Mean RS | 2.36 | 2.83 | 2.53 | 2.48 |
| Mean Underwriter Reputation | 3.06 | 2.83 | 2.89 | 2.90 |

*0.05 level of significance, **0.01 level of significance.

coefficient had a value of .338 with a t-test statistic of 9.68, significant at the 0.01 level. These tests support the use of LOGHL as a proxy for risk.

For additional tests of the power of LOGHL (and a drift adjusted version RS of the extreme value estimator derived by Rogers and Satchell [1991]), we perform a series of regressions. In the following series of regressions, we regress the proxies for uncertainty DUMCL and risk LOGHL and RS, along with two control variables that are commonly used in other underpricing studies as proxies for risk: REP and INVGP on underpricing. The results for the entire sample are reported in Table 2. For each of the individual simple regressions of the entire sample, the variables are significant and has the predicted sign. However, when all four explanatory variables are regressed simultaneously on initial returns only LOGHL is significant and has the predicted sign. For the univariate regression using LOGHL the r-squared is 13.7% and only increases to 14.3% for the multivariate regression using all of the explanatory variables. This supports our proposition that other proxies for risk are weaker than LOGHP as explanatory variables for IPO returns.

In a further series of regressions, we use three sub-samples of the data comprising industrial firms, closed-end funds, and financial institutions. The results are reported in Tables 3, 4, and 5, respectively. For the industrial IPOs the results reported in Table 3 are similar to those for the entire sample. However, for closed-end funds and financial institutions where asymmetric information is reduced, the LOGHL is much stronger in explaining underpricing, as indicated in Tables 4 and 5. This result would be expected if LOGHL is a strong proxy for risk. Asymmetric information is reduced for closed end funds because their assets are primarily securities whose values can be well established. Since about 80% of the financial institutions in our sample were federally regulated savings and loans institutions and most of the remainder were commercial banks, asymmetric information is reduced by the filing of more detailed statements with the various regulatory agencies.

## CONCLUSIONS

IPO empirical studies have used many different proxies for ex-ante risk. In this essay, we provide evidence that LOGHL is a better proxy for ex-ante risk than the others. Consequently, previous studies that have rejected the explanatory of ex-ante risk to explain initial IPO returns are questionable; our study indicates that in certain industries, our proxy for risk can explain almost as much of the initial IPO returns as historical variances might for seasoned issues. Nonetheless, our results based on the sub-sample drawn from industrial IPOs concur with earlier studies in suggesting that other factors such as information asymmetries must explain at least part of the IPO underpricing phenomena.

## TABLE 2

**For Entire Sample (1) Least Squares Regression and (2) Spearman Correlation Coefficient Results with Initial Return ($R_{1D}$) as Dependent Variable, and Rogers-Satchell (RS), Underwriter Reputation (REP), Inverse of Gross Proceeds (INVGP) and Industry Dummy (DUMCL) as Independent Variables.**

**The t-statistics are in parentheses, N is the sample size.**

**(1) ENTIRE SAMPLE ORDINARY LEAST SQUARES RESULTS (N=822)**

| Const | RS | REP | INVGP | DUMCL | R-SQ | F-STAT |
|---|---|---|---|---|---|---|
| -0.2549<br>(-8.94)** | 0.1210<br>(10.65)** | | | | 0.126 | 113.45** |
| 0.014<br>(5.6) | | -0.0138<br>(-2.7)** | | | 0.01 | 7.5** |
| 0.037<br>(6.3) | | | 0.1469<br>(2.48)* | | 0.01 | 6.2** |
| 0.053<br>(11.0) | | | | -0.0493<br>(-3.9)** | 0.02 | 15.2** |
| 0.031<br>(1.7) | 1.1431<br>(10.5)** | -0.0079<br>(-1.51) | -0.1401<br>(-2.14)* | -0.0184<br>(-1.4) | 0.14 | 34.2** |

**(2) ENTIRE SAMPLE SPEARMAN CORRELATION COEFFICIENT RESULTS (N=822)**

| | LOGHL | REP | INVGP | DUMCL |
|---|---|---|---|---|
| Spearman<br>Corr. Coef. | 0.338<br>(9.68)** | -0.061<br>(-1.74) | 0.152<br>(4.37)** | 0.205<br>(5.88)** |

*0.05 level of significance, **0.01 level of significance.

## ENDNOTES

1. Welch (1989) and Allen and Faulhaber (1989) also develop signalling models where underpricing is a direct signal to the market about the value of a firm.

2. Numerous other studies have found that issues underwritten by low-prestige investment banks have higher initial returns than high-prestige investment banks. Among these studies are McDonald and Fischer (1972), Logue (1973), Neuberger and Hammond (1974), Block and Stanley (1980), and Neuberger and LaChapelle (1983), and Johnson and Miller (1987).

3. The Securities Act of 1933 requires all parties to an offering to perform “due diligence” and requires that all parties attempt to include all relevant information in the prospectus. If any party neglects its “due diligence”, it may be subject to criminal and/or civil prosecution.

4. Barry and Jennings did the same test on their data but did not find a significant difference between the mean of over- and under-priced issues. However, Barry and Jennings only had a sample size of 229. Furthermore, their sample only included issues where the first traded price was available. Because the first traded price is more likely to be available for larger and less speculative issues, their sample is probably biased against finding significant results.

## TABLE 3

**For Industrial IPOs (1) Least Squares Regression and (2) Spearman Correlation Coefficient Results with Initial Return ($R_{1D}$) as Dependent Variable, and Log[High First Day Price Range/Low First Day Price Range] (LOGHL), Underwriter Reputation (REP), and Inverse of Gross Proceeds (INVGP) as Independent Variables.**

**The t-statistics are in parentheses, N is the sample size.**

**(1) INDUSTRIAL ORDINARY LEAST SQUARES RESULTS (N=606)**

| Constant | LOGHL | REP | INVGP | R-SQ | F-STAT |
|---|---|---|---|---|---|
| 0.0031<br>(0.39) | 1.0907<br>(8.68)** | | | 0.12 | 75.30** |
| 0.1070<br>(5.39)** | | -0.0183<br>(-2.78)** | | 0.01 | 7.73** |
| 0.0493<br>(5.65)** | | | 0.0771<br>(0.71) | 0.00 | 0.50 |
| 0.0899<br>(3.18)* | 1.1714<br>(8.91)** | -0.0221<br>(-2.88)** | -0.4442<br>(-3.40)* | 0.13 | 29.86** |

**(2) INDUSTRIAL SPEARMAN CORRELATION COEFFICIENT RESULTS (N=606)**

| | LOGHL | REP | INVGP |
|---|---|---|---|
| Spearman<br>Corr. Coef. | 0.247<br>(6.07)** | -0.077<br>(-1.91) | 0.021<br>(0.51)* |

*0.05 level of significance, **0.01 level of significance.

## REFERENCES


1. Allen, F. and G. Faulhaber, "Signalling by Underpricing in the IPO Market," *Journal of Financial Economics* 23, 1989, pp. 303-323.

2. Barry, C.B. and R.H. Jennings, "The Opening Price Performance of Initial Public Offerings of Common Stock," presented at the 1991 Financial Management Association Meetings in Chicago, 1991.

3. Beatty R. and J. Ritter, "Investment Banking, Reputation, and the Underpricing of Initial Public Offerings," *Journal of Financial Economics* 15, 1986, pp. 213-232.

4. Block, S. and M. Stanley, "The Financial Characteristics and Price Movement Patterns of Companies Approaching the Unseasoned Securities Market in the Late 1970s," *Financial Management*, Winter 1980, pp. 30-36.

5. Booth, J.R. and R.L. Smith II, "Capital Raising, Underwriting and the Certification Hypothesis," *Journal of Financial Economics* 15, 1986, pp. 261-281.

6. Carter, R.B. and S. Manaster, "Initial Public Offerings and Underwriter Reputation," *Journal of Finance*, 1990.

7. Chalk, A.J. and J.W. Peavy, "Initial Public Offerings: Daily Returns, Offering Types and the Price Effect," *Financial Analysts Journal*, September/October 1987, pp. 65-70.

## TABLE 4

**For Closed-end Funds (1) Least Squares Regression and (2) Spearman Correlation Coefficient Results with Initial Return ($R_{1D}$) as Dependent Variable, and Log[High First Day Price Range/Low First Day Price Range] (LOGHL), Underwriter Reputation (REP), and Inverse of Gross Proceeds (INVGP) as Independent Variables.**

**The t-statistics are in parentheses, N is the sample size.**

**(1) CLOSED-END FUNDS ORDINARY LEAST SQUARES RESULTS (N=119)**

| Constant | LOGHL | REP | INVGP | R-SQ | F-STAT |
|---|---|---|---|---|---|
| -0.0183<br>(-2.82)** | 1.4855<br>(6.17)** | | | 0.245 | 38.03** |
| -0.0827<br>(-2.96)** | | 0.0284<br>(3.17)** | | 0.079 | 10.07** |
| 0.0043<br>(0.59) | | | -0.0328<br>(0.12) | 0.001 | 0.01 |
| -0.1160<br>(-2.62)** | 1.4079<br>(5.65)** | 0.0187<br>(2.15)* | -0.1160<br>(-0.45) | 0.285 | 15.29** |

**(2) CLOSED-END FUNDS SPEARMAN CORRELATION COEFFICIENT RESULTS (N=119)**

| | LOGHL | REP | INVGP |
|---|---|---|---|
| Spearman<br>Corr. Coef. | -0.024<br>(-0.26) | 0.038<br>(0.14) | 0.139<br>(1.51) |

*0.05 level of significance, **0.01 level of significance.


8. Grinblatt, M. and C.Y. Hwang, "Signalling and the Pricing of New Issues," *Journal of Finance* 44, 1988, pp. 393-420.

9. Howard & Company, Going Public: The IPO Reporter, 1986-1989.

10. Ibbotson, R.G., "Price Performance of Common Stock New Issues," *Journal of Financial Economics* 2, 1975, pp. 235-272.

11. Johnson, J.M. and R.E. Miller, "Investment Banker Prestige and the Underpricing of Initial Public Offerings," *Financial Management*, Summer 1988, pp. 19-29.

12. Logue, D.E., "On the Pricing of Unseasoned Equity Issues: 1965-1969," *Journal of Financial and Quantitative Analysis* 8, 1973, pp. 91-103.

13. McDonald, J. and A.K. Fisher, "New Issue Stock Price Behavior," *Journal of Finance* 27, 1972, pp. 97-102.

14. Muscarella, C.J. and M.R. Vetsuypens, "A Simple Test of Baron's Model of IPO Underpricing," *Journal of Financial Economics* 24, 1989a, pp. 125-135.

15. Muscarella, C.J. and M.R. Vetsuypens, "The Underpricing of `Second' Initial Public Offerings," *Journal of Financial Research* 12, 1989b, pp. 183-192.

## TABLE 5

**For Financial Institutions (1) Least Squares Regression and (2) Spearman Correlation Coefficient Results with Initial Return ($R_{1D}$) as Dependent Variable, and Log[High First Day Price Range/Low First Day Price Range] (LOGHL), Underwriter Reputation (REP), and Inverse of Gross Proceeds (INVGP) as Independent Variables.**

**The t-statistics are in parentheses, N is the sample size.**

**(1) FINANCIAL INSTITUTIONS ORDINARY LEAST SQUARES RESULTS (N=97)**

| Constant | LOGHL | REP | INVGP | R-SQ | F-STAT |
|---|---|---|---|---|---|
| -0.0141<br>(-1.35) | 1.0952<br>(6.96)** | | | 0.34 | 48.44 |
| 0.0719<br>(3.70)** | | -0.0090<br>(-1.40) | | 0.02 | 1.96 |
| 0.0236<br>(2.49)* | | | 0.1601<br>(3.42)** | 0.11 | 11.70 |
| -0.0202<br>(-0.94) | 1.0088<br>(5.84)** | 0.0008<br>(0.15) | 0.0592<br>(1.29) | 0.35 | 16.67 |

**(2) FINANCIAL INSTITUTIONS SPEARMAN CORRELATION COEFFICIENT RESULTS (N=97)**

| | LOGHL | REP | INVGP |
|---|---|---|---|
| Spearman<br>Corr. Coef. | 0.629<br>6.16** | -0.212<br>-2.08* | 0.427<br>(0.43) |

*0.05 level of significance, **0.01 level of significance.

16. Neuberger, B.M. and C.T. Hammond, "A Study of Underwriters' Experience with Unseasoned New Issues," *Journal of Financial and Quantitative Analysis*, March 1974, pp. 165-177.

17. Neuberger, B.M. and C.A. LaChapelle, "Unseasoned New Issue Price Performance on Three Tiers: 1975-1980," *Financial Management*, Autumn, 1983, pp. 23-28.

18. Parkinson, M., "The Extreme Value Method for Estimating the variance of the Rate of Return," *Journal of Business* 57, 1980, pp. 61-65.

19. Peavy, J.W., "Returns on Initial Public Offerings of Closed-End Funds," *Review of Financial Studies* 3, 1990, pp. 695-708.

20. Rock, K., "Why New Issues are Underpriced," *Journal of Financial Economics* 15, 1986, pp. 187-212.

21. Rogers, L.C.G. and Satchell, S.E., "Estimating Variance from High, Low and Closing Prices," *The Annals of Applied Probability* 1, 1991, pp. 504-512.

22. Tinic, S.M., "Anatomy of Initial Public Offerings of Common Stock," *Journal of Finance* 43, 1988, pp. 789-822.

23. Weiss, K.A., "The Post-Offering Price Performance of Closed-End Funds," *Financial Management* 18, 1989, pp. 57-67.

24. Welch, I., "Seasoned Offering, Imitation Costs and the Underpricing of Initial Public Offerings," *Journal of Finance* 44, 1988, pp. 421-449.