International Journal of Economics and Finance; Vol. 8, No. 2; 2016
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

# Factors of IPO Underpricing

Kenneth S. Choie[1]

[1] Graduate School of Business, Sejong University, Seoul, Korea

Correspondence: Kenneth S. Choie, Graduate School of Business, Sejong University, Seoul, Korea. Tel: 82-10-9174-6810. E-mail: kchoie@sejong.ac.kr

Received: November 23, 2015 Accepted: December 10, 2015 Online Published: January 25, 2016

doi:10.5539/ijef.v8n2p107 URL: http://dx.doi.org/10.5539/ijef.v8n2p107

*This research was supported by Sejong University Research Grant.*

**Abstract**

This paper examines why the degree of underpricing of IPOs in Korea is much greater than in the U.S. The analysis shows that both the issuing firm and its underwriter tend to set the IPO price below the mean of the probability distribution of initial market price; the magnitude of IPO underpricing depends positively on the uncertainty of the initial market price and the marginal cost of making aftermarket, and negatively on the size of underwriter's spread. The structural differences in these factors explain the observed difference in the IPO data of the U.S. and Korea.

**Keywords:** IPOs, initial public offerings, underpricing

## 1. Introduction

Nearly two-third of 8,759 equity IPOs offered in the U.S. between 1965 and 2005 had a positive initial monthly return. Similarly, 61% of 756 IPOs made in Korea between 2001and 2011 also had a positive initial monthly return. However, the difference in the magnitudes of IPO underpricing in the two equity markets was quite huge. The average first-day return in Korea was a whopping 42.9% in the 2001 through 2011 period, whereas the average first-day IPO returns in the U.S. was 7% in the 1980s, 15% in the 1990's and 12% during the period of 2001-2003. The average initial monthly return of 30.2% in Korea was also much greater than that of 22% in the U.S.

Why was the degree of underpricing of IPOs in Korea much greater than in the U.S.? A huge body of literature in finance has investigated the underpricing of IPOs. The most widely held view of IPO underpricing is that the conflict of interests between the issuing firm and their underwriter is the cause, and that the occurrence of informational asymmetry between the two parties allows the underwriter to sway the issuing firm. This line of reasoning may explain why underpricing of IPOs would happen, but does not adequately explain why difference in the magnitudes of IPO underpricing in different markets would occur. This paper identifies the factors determining IPO underpricing which explain the observed difference in the extent of underpricing in the two IPO markets.

The literature on the IPO underpricing can be put into two groups: the first category focuses on issuing firm to explain the underpricing phenomena and the second on underwriter. The first group of explanations argues that issuing firms underprice IPOs in a calculated move. Ritter (1984) and Rock (1986) say that the issuers offer a discount to attract the uninformed investors into the market. Welch (1989) and Chemmanur (1993) suspect that high quality issuers sell their shares at a lower price than the market believes they are worth in order to signal their quality. Aggarwal et al. (2002) and Cliff and Denis (2004) assert that issuing firms crave the additional analyst coverage and are willing to pay for it in the form of underpricing.

The second group of explanations argues that the underwriting investment banks underprice IPOs for a variety of reasons. Baron (1982), Sherman and Titman (2002) assume that the investment bank is better informed about the market than the issuer, and that the issuing firm accepts the underwriter's IPO price because of the informational asymmetry. Benveniste and Spindt (1989), Cornelli and Goldreich (1999), and Jenkinson and Ljungqvist (2001) say that underwriters give allocation priority of underpriced IPO shares to prospective investors in order to elicit private information from them when the underwriters collect indications of interests.

Loughran and Ritter (2002) assert that underwriters would have an incentive to recommend lower offer prices to issuers, if they receive compensation from both issuers and investors. Liu and Ritter (2010) suspect that the underpricing is a consequence of spinning where underwriters allocate hot IPO shares to the personal brokerage accounts of the executives of firms that plan to go public (Note 1). Loughran and Ritter (2004) suggest that allocations of hot IPOs to the personal brokerage accounts of issuing firm executives create an incentive for the beneficiaries to seek underwriters who tend to severely underprice IPOs. Ellis et al. (2000), Boehmer and Fisher (2001, 2004) investigate if underwriters have an incentive to underprice IPOs when the underwriter can gain additional revenue from trading the underpriced shares. Yeoman (2001) constructs an optimization problem for the investment bank under the assumption that the investment bank aims to maximize the net proceeds to the issuing firm.

This paper analyzes the optimal IPO price from the perspective of the issuing firm and its underwriter. The only assumption made in this analysis is that both the issuing firm and its underwriter seek probability-based optimal IPO price. This paper shows that the issuing firm would tend to set the IPO price below the expected initial market price to ensure a successful IPO, and that the underwriting investment banker's expected-profit-maximizing IPO price is lower than the expected initial market price of the share. It follows that the IPO price agreed upon between the issuing firm and its underwriter would likely to be lower than the expected initial market price, and as such the IPO price would often be lower than the actual initial market price. In particular, the analysis indicates that the magnitude of underpricing would depend on three factors: the uncertainty about the initial market price, the underwriter's spread, and the marginal cost of making aftermarket. These factors of underpricing explain better the greater underpricing of IPOs in Korea compared to the IPOs in the U.S.

## 2. Issuing Firm'S Optimal IPO Price versus the (Expected) Initial Market Price

The common regulatory constraint on the IPO day is that the issuing firm must not sell the shares to investors at a price above the IPO price while the issuing firm may sell the shares at a price below the IPO price. As such, the issuing firm has to weigh two counter-balancing considerations. The stakeholders of the issuing firm, its start-up entrepreneurs and venture capitalists, would naturally prefer the highest price possible to maximize the proceeds. At the same time, the stakeholders of the issuing firm would want to avoid, *ex-ante*, a failed IPO, even if the immediate financial burden of a failed IPO would fall on the underwriter. The reasoning for that is as follows. To send a positive signal to the prospective investors, and thereby increase the probability of the IPO's success, the stakeholders of an IPO firm often retain a substantial portion of their interests in the firm. Hence, a failed IPO would spoil for the stakeholders any prospect of converting their retained interests in the near future, and the stakeholders would dread a failed IPO.

How would the issuing firm pick the IPO price for its shares? The first thing the issuing firm must do is to estimate the initial market clearing price. The indications of interest collected from prospective investors by its underwriter would serve as the basis for this estimation. The reliability of the probability distribution of initial market price, however, may be in question because the distribution is based on the indications of interest by prospective investors, not firm orders. The prospective investors have an incentive, when they express interests, to inflate the price of the IPO shares just to ensure that they get a priority in share allocations. Further, any prospective investor evaluating the IPO firm has to do with a relatively limited availability of financial information compared to a public company.

It is, for lack of better alternative, reasonable for the issuing firm and its underwriter to estimate the initial market price from the indications of interest collected. Suppose that a probability distribution of the (expected) initial market price of the IPO share summarizes the indications of interest collected. The mean of the probability distribution may be an obvious candidate for the IPO price from the perspective of the issuing firm. There is, however, one glaring problem with setting the IPO at the mean of the distribution. The probability of IPO failure would be close to 50% when the IPO price is set at the mean of the distribution, if the probability distribution is roughly accurate and symmetrical. Hence, the issuing firm should pick an IPO price below the median of the probability distribution of the initial market price, if the stakeholders of the issuing firm are seeking a probability of IPO failure less than 50%. In particular, if the distribution follows approximately lognormal, the firm's IPO price should be set below the mean of the probability distribution of initial market price (i.e., lognormal distribution is positively skewed, and its cumulative probability up to the mean of the distribution is greater than that to the median).

The upshot is that it would be only prudent for the issuing firm to set the IPO at a level where the implied probability of IPO failure is acceptable to the stakeholders: set the IPO price below the mean of the probability

distribution of the (expected) initial market price. The gap between the chosen IPO price and the mean of probability distribution serves as a margin of safety for the issuing firm, and the size of the gap would depend upon the risk tolerance of the stakeholders of the issuing firm.

### 3. Underwriter's Optimal IPO Price versus the (Expected) Initial Market Price

The underwriting investment bank incurring great expenses collects indications of interest from potential investors in the pre-IPO period. In setting the IPO price together with the issuing firm, the regulatory price-inflexibility on the IPO day also places the underwriter squarely in the place where the underwriter is torn between greed and fear. The higher the IPO price, the greater is the underwriter's potential income because the gross underwriting income is a certain percentage of the IPO price. The higher the IPO price, however, the greater is the probability that the IPO would fail. Should the IPO fail (i.e., Should the IPO price turn out to be higher than the initial market price), the underwriting investment bank would have to sell the shares below the IPO price, and incur additional expenses to make market for the shares. As such, the underwriter must balance the regret it would have, should the IPO price turn out to be too low against the possibility of having to incur extra costs should the IPO price turn out to be too high.

For the purpose of analyzing how the underwriter would determine the optimal IPO price from its perspective, let us assume that the underwriter's sole objective is to choose IPO price that maximizes its own net expected underwriting income. If the (expected) initial market price follows a certain probability distribution function, the equation below specifies the underwriter's objective:

$$\underset{y}{\text{Max N}} = \int_{y}^{\infty} [\, y - (1-s)y - c \,]\ f(x)\ dx + \int_{0}^{y} \{\, x - [\, (1-s)y + c + v(y-x)\,]\,\}\, f(x)dx \tag{1}$$

Where, N is the net expected underwriting income, y is the IPO price, s is the underwriting spread for the investment bank, c is the pre-IPO marketing expenses paid, f(x) is the probability distribution function of the (expected) initial market price, and v is the marginal rate of additional post-IPO expenses when the market price turns out to be lower than the IPO price. The first integral in Equation (1) represents the event where the market price is greater than the IPO price; the second integral in Equation (1) represents the outcome where the market price is below the IPO price.

The first derivative of the expected-profit maximizing IPO price is (Note 2):

$$\frac{\partial N}{\partial y} = s - (1+v)\int_{0}^{y} f(x)dx) = s - (1+v)F(y) \tag{2}$$

Where, F(y) is the cumulative probability distribution of initial market price when the initial market price is equal to the IPO price (i.e., x = y). At the optimal IPO price, Equation (2) becomes equal to zero:

$$\frac{\partial N}{\partial y}\ \Big|_{\,y = y^*} = 0 = s - (1+v)\ F(y^*) \tag{3}$$

That is, the underwriter's expected-profit maximizing IPO price would be such that the cumulative probability at the chosen IPO price is equal to $\frac{s}{1+v}$ [i.e., $F(y^*) = (\frac{s}{1+v})$]. Equation (3) indicates that underwriter's optimal IPO depends on the probability distribution of initial market price [f(x)], the marginal cost of making aftermarket (v), and the size of underwriter's spread (s). Note that the underwriter's optimal IPO price would depend positively on the size of underwriter's spread (s) and negatively on the marginal cost of making aftermarket (v). Note, in particular, that the cumulative probability at the optimal IPO price is less than 0.5 when the underwriting spread, s, is less than 50% as in practice; if the probability distribution of the initial market price is positively skewed, as is the case of a lognormal distribution, the optimal IPO price is unequivocally less than the mean of the probability distribution of the initial market price (Note 3).

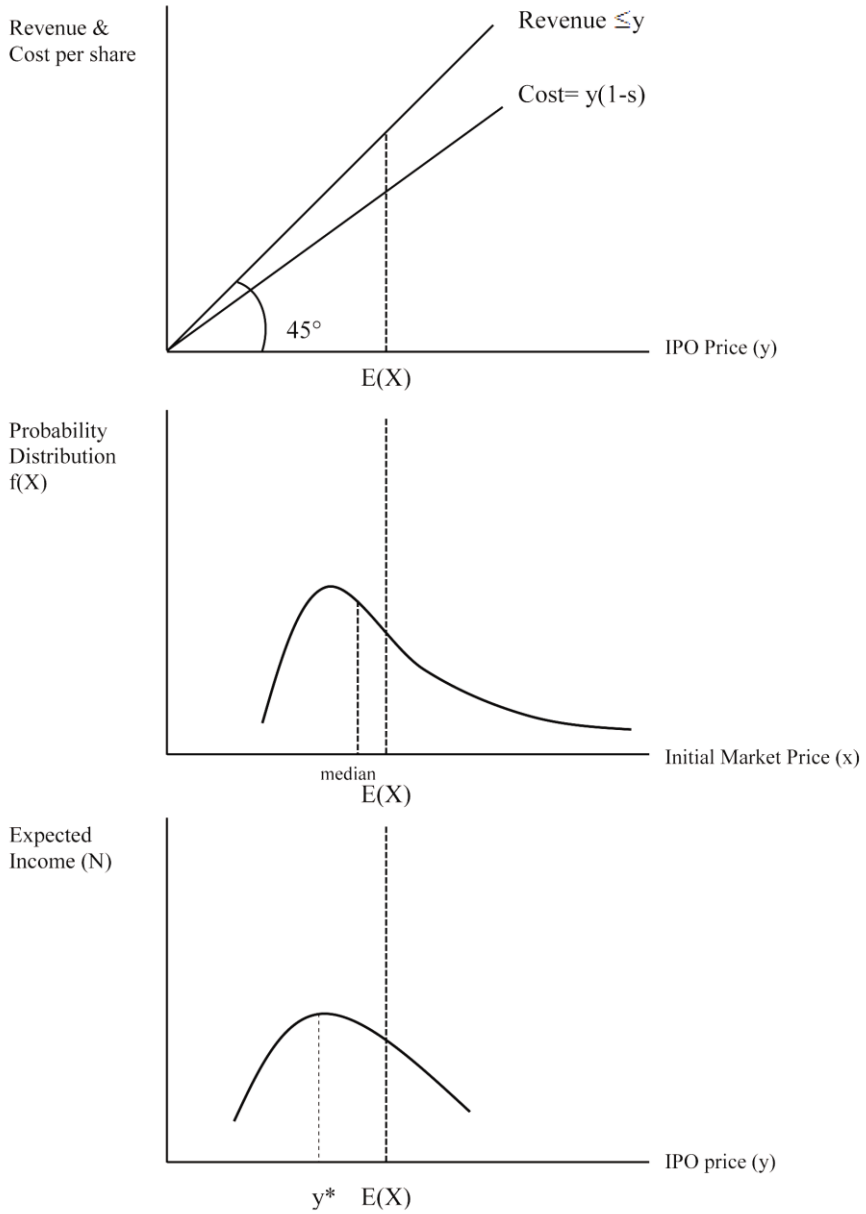


Figure 1. The underwriter's expected-profit maximizing IPO price, y*

Figure 1 shows the maximum revenue and cost per share to the underwriter (top panel); the relative positions of the median and mean of an approximately lognormal probability distribution (middle panel); the expected net underwriting income to the underwriter at various levels of IPO price (bottom panel). The bottom panel of Figure 1 shows that the underwriter's optimal IPO price, y*, is lower than the expected market price, E(X). It indicates that the gap between the optimal IPO price and the (expected) initial market price depends on the variance of the probability distribution, the underwriter's spread, and the marginal cost of making aftermarket for the shares [i.e., F (y*) = $\frac{s}{1+v}$ < 0.5 < F [E(x)].

**4. Analytical Predictions and Observed Empirical Findings**

The issuing firm and its underwriter would attempt to close any difference between their respective optimal IPO prices through price negotiations. Regardless of the intricacies of the negotiation process in which the

underwriter may sway the issuing firm with perceived informational superiority on the prospective buyers, the agreed-upon IPO price would tend to be lower than the expected market price because the respective optimal IPO prices of the two parties are likely to be below the (expected) initial market price (Note 4).

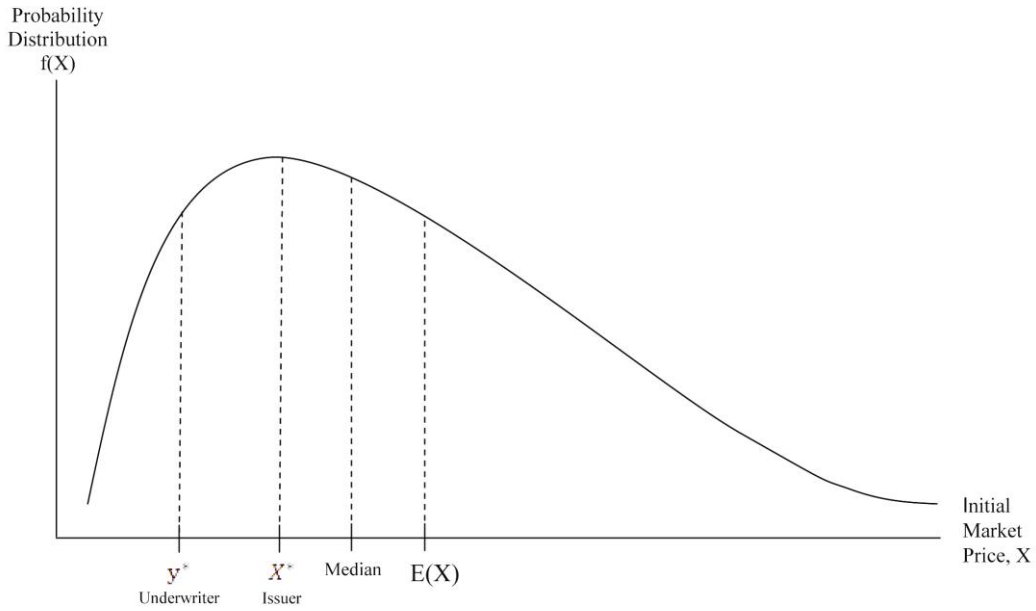


Figure 2. The optimal IPO prices of the issuer and the underwriter

Figure 2 shows the optimal IPO prices preferred by the issuing firm and its underwriter, when the initial market price approximately follows a lognormal distribution. The gap between the agreed-upon IPO price and the expected market price would depend primarily on the variance of probability distribution of the initial market price: as the probability distribution gets tighter, any gap between the agreed-upon price and the (expected) initial market price would also get smaller.

The gap between the agreed-upon IPO price and the expected market price would also depend on the difference between two optimal IPO prices of the issuing firm and its underwriter are, respectively. The analysis presented above on the underwriter's optimal IPO price indicates that the underwriter's optimal IPO price would be higher as the underwriting spread gets larger, and lower as the marginal cost of making aftermarket get larger. As such the gap between the agreed-upon IPO price and the expected market price the agreed-upon IPO price would be smaller as the underwriter's spread increases, and larger as the marginal cost of making aftermarket increases. In sum, the analysis predicts that the magnitude of underpricing (i.e., the difference between the agreed-upon IPO price and the expected initial market price) would depend negatively on the size of underwriter's spread, and positively on the marginal cost of making aftermarket and the variance of probability distribution of the (expected) initial market price.

Table 1. Initial performance of IPOs in Korea, 2001-2011

| | 1st Day Performance | 1st Month Performance |
|---|---|---|
| Average Rate of Return | 42.90% | 30.20% |
| Number of Positive Returns | 610 | 463 |
| Number of Negative Returns | 132 | 284 |
| No Change | 14 | 9 |
| Total number of IPOs | 756 | 756 |

*Note*. Data Source.

Firms -http://www.krx.co.kr/m6/m6_1/m6_1_3/m6_1_3_1/JHPKOR06001_03_01.jsp

Price - http://www.krx.co.kr/m2/m2_1/m2_1_4/JHPKOR02001_04.jsp

The average first-day IPO return in Korea was 42.9% in the 2001 through 2011 period (see Table 1), whereas the

average first-day IPO returns in the U.S. was 7% in the 1980s, 15% in the 1990's and 12% during the period of 2001-2003 (Loughran & Ritter, 2004). The average initial monthly return, as measured by the difference between the aftermarket price on the 21st day of trading and the offer price, in Korea was also much greater than that in the U.S.: 30.2% in Korea versus 22% in the U.S. (Lowry et al., 2010).

To explain the difference in the magnitudes of IPO underpricing in the two equity markets, let us now consider the three factors of underpricing identified in the preceding analysis: variance of the probability distribution of the (expected) initial market price, underwriting spread, and the aftermarket expenses. First, the variances of the initial market prices are larger in Korea than those in the U.S. because the U.S. has a much larger investor pool than Korea, *ceteris paribus*. Second, the underwriter's spread is smaller in Korea than in the U.S., about 4% in Korea as compared to 7% in the U.S. (Kim & Lee, 2006) report that the underwriting spread is 4% in Korea; Chen and Ritter (2000) find that equity IPO spreads are clustered at 7% in the U.S. Third, the cost of making aftermarket in Korea was higher in most of the study period than in the U.S. In Korea, non-institutional investors had a put-option to sell their shares back to the underwriter at the 90% of the IPO price in the first month after the issue date (Kim & Lee, 2006).

According to the prediction of the analysis, the degree of IPO underpricing would be greater in Korea than in the U.S. because the uncertainty is greater, underwriting spread is smaller, and the aftermarket expense is larger in Korea compared to the U.S. Hence, the empirical data are consistent with the analytical prediction.

## 5. Conclusion

This paper examines why the degree of underpricing of IPOs in Korea is much greater than in the U.S. This paper first presents the analysis of the optimal IPO price from the perspectives of both the issuing firm and its underwriting investment bank. The stakeholders of the issuing firm would aim to avoid a failed IPO as much as to get the maximum price for the shares: the issuing firm would prefer to set the IPO price below the expected initial market price (i.e., the mean of the probability distribution of expected initial market price) to decrease the probability of IPO failure to a level below 50%. The underwriting investment bank's expected-profit maximizing IPO price is also lower than the median of the probability distribution of the initial market price; in particular, below the mean if the probability distribution is approximately lognormal. As such, the agreed-upon IPO price between issuing firm and its underwriter would tend to be below the expected initial market price. Hence, the IPO price is likely to be lower than the actual initial market price.

The analysis also identifies three factors that determine the magnitude of IPO underpricing: the variance of the probability distribution of the initial market price, underwriter's spread, and the marginal cost of making the after-market. Specifically, the analysis predicts that the magnitude of IPO underpricing would depend positively on the variance of the probability distribution of the initial market price and the marginal cost of making aftermarket, and inversely on the underwriter's spread. The analysis predicts that IPOs would be underpriced more in Korea than in the U.S. because the uncertainty is greater, underwriting spread is smaller, and the aftermarket expense is larger in Korea as compared to the U.S. That is, the structural differences in factors identified in the analysis explain the observed difference in the magnitudes of IPO underpricing in the U.S. and Korea.

## References

Aggarwal, R., Krigman, L., & Womack, K. (2002). Strategic IPO underpricing, Information momentum, and Lockup Expiration Selling. *Journal of Financial Economics, 66*, 105-137. http://dx.doi.org/10.1016/S0304-405X(02)00152-6

Baron, D. (1982). A model of the demand for investment banking advising and distribution services for new issues. *Journal of Finance, 37*, 955-976. http://dx.doi.org/10.1111/j.1540-6261.1982.tb03591.x

Beatty, R., & Ritter, J. (1986). Investment banking, reputation, and the under-pricing of initial public offerings. *Journal of Financial Economics, 15*, 213-232. http://dx.doi.org/10.1016/0304-405X(86)90055-3

Benveniste, L., & Spindt, P. (1989). How investment bankers determine the offer price and allocation of new issues. *Journal of Financial Economics, 24*, 343-362. http://dx.doi.org/10.1016/0304-405X(89)90051-2

Boehmer, E., & Fisher, P. (2004). Underwriter short covering in the IPO aftermarket: A clinical study. *Journal of Corporate Finance, 10*(4), 575-594. http://dx.doi.org/10.1016/S0929-1199(03)00021-X

Chemmanur, T. (1993). The pricing of initial public offers: A dynamic model with information production. *Journal of Finance, 48*, 285-304. http://dx.doi.org/10.1111/j.1540-6261.1993.tb04710.x

Chen, H., & Ritter, J. (2000). The seven percent solution. *Journal of Finance, 55*, 1105-1131.

http://dx.doi.org/10.1111/0022-1082.00242

Cliff, M., & Denis, D. (2004). Do IPO Firms Purchase Analyst Coverage with Underpricing? *Journal of Finance, 59*, 871-901. http://dx.doi.org/10.1111/j.1540-6261.2004.00719.x

Cornelli, F., & Doldreich, D. (2001). Book-building and Strategic Allocation. *Journal of Finance, 56*, 2337-2369. http://dx.doi.org/10.1111/0022-1082.00407

Ellis, K., Michaely, R., & O'Hara, M. (2000). When underwriter is the market maker: An examination of trading in the IPO aftermarket. *Journal of Finance, 55*,1039-1074. http://dx.doi.org/10.1111/0022-1082.00240

Jenkenson, T., & Lyungqvist, A. (2001). *Going Public: The Theory and Evidence on How Companies Raise Equity Finance* (2nd ed.). Oxford, UK: Oxford University press.

Kim, S., & Lee, S. (2006). Underpricing of IPOs and Underwriters' Market Making Activities. *Journal of Korean Security Academy, 35*(3), 142-174.

Liu, X., & Ritter, J. (2010). The Economic Consequences of IPO Spinning. *Review of Financial Studies, 23*(5), 2024-2059. http://dx.doi.org/10.1093/rfs/hhq002

Loughran, T., & Ritter, J. (2002). Why don't issuers get upset about leaving money on the table in IPOs? *Review of Financial Studies, 15*, 413-443. http://dx.doi.org/10.1093/rfs/15.2.413

Loughran, T., & Ritter, J. (2004). Why Has IPO Underpricing Changed Over Time? *Financial Management*, Autumn 2004, 5-37.

Lowry, M., Officer, M., & Schwert, W. (2010). The variability of IPO initial returns. *Journal of Finance*, April, 425-465. http://dx.doi.org/10.1111/j.1540-6261.2009.01540.x

Nanda, V., & Yun, Y. (1997). Reputation and financial intermediation: An empirical investigation of the impact of IPO mispricing on underwriter market value. *Journal of Financial Intermediation, 6*, 39-63. http://dx.doi.org/10.1006/jfin.1996.0208

Ritter, J. (1984). The "hot issue" market of 1980. *Journal of Business, 57*, 215-240. http://dx.doi.org/10.1086/296260

Rock, K. (1986). Why new issues are underpriced. *Journal of Financial Economics, 15*, 187-212. http://dx.doi.org/10.1016/0304-405X(86)90054-1

The Wall Street Journal. (1997). Underwriters set aside IPO stock for officials of potential customers, A1; December 12 2000, Linux deal is focus of IPO commission probe, C1; August 10 2001, CSFB official set quota for repayment of IPO profits in form of commissions, C1.

Welch, I. (1989). Seasoned offerings, imitation costs, and the underpricing of initial public offerings. *Journal of Finance, 44*, 421-450. http://dx.doi.org/10.1111/j.1540-6261.1989.tb05064.x

Welch, I. (1992). Sequential sales, learning, and cascades. *Journal of Finance, 47*, 695-732. http://dx.doi.org/10.1111/j.1540-6261.1992.tb04406.x

Yeoman, J. (2001). The optimal spread and offering price for underwritten securities. *Journal of Financial Economics, 62*, 169-198. http://dx.doi.org/10.1016/S0304-405X(01)00076-9

**Notes**

Note 1. *The Wall Street Journal* reported a practice known as "spinning" in which investment bankers use underpriced shares to enrich buy-side clients in return for commission business (2000, 2001), or to curry favor from executives of other prospective IPO issuers, or even politicians (1997).

Note 2. Equation (1) can be rewritten as follows:

$$= \int_y^{\infty} [y - y + sy - c]\, f(x)\, dx + \int_0^y (x - y + sy - c - vy + vx) f(x) dx$$

$$= \int_y^{\infty} [sy - c]\, f(x) dx + \int_0^y [(sy - c) + (x - y)(1 + v)] f(x) dx$$

$$= \int_y^{\infty} [\,sy - c]\ f(x)\ dx\ + \int_0^y (sy - c) f(x) dx\ + \int_0^y [(x - y)(1 + v)]\ f(x) dx$$

$$= (sy - c) + (1 + v) \int_0^y (x - y)\, f(x)dx$$

Note 3. The median of a positively skewed probability distribution function is less than its mean (i.e., the cumulative probability at the mean of the initial market price is greater than 0.5). For instance, when the spread for the underwriter is below 10%, F (y*) = $\frac{s}{1+v}$ < 0.1 < 0.5 < F [E(x)]. If the probability distribution function is symmetrical, the underwriter's optimal IPO price is still lower than the mean of the probability distribution {i.e., y* < E(x) because F (y*) = $\frac{s}{1+v}$ < 0.1 < 0.5 = F [E(x)]}. If the probability distribution function is negatively skewed, then the investment bank's expected-profit maximizing IPO price can be higher than its expected market price {i.e., y* > E(x), if F(y*) > F [E(x)]}. Suppose the probabilities of the initial market price being \$0 and \$100 are 5% and 95% respectively {i.e., E(x) = \$95, and F [E(x)] = 0.05}. In this case, the underwriter's optimal IPO price would be higher than the expected market price, as $\frac{s}{1+v}$ is greater than 0.05 {i.e., y* > E(x) if F (y*) = $\frac{s}{1+v}$ > F [E(x)] = 0.05}.

Note 4. The more risk-averse the stakeholders of the issuing firm are, the smaller would any gap between the two optimal IPO prices be. Suppose that the issuing firm sets the IPO price representing the probability of IPO failure of 5%. The cumulative probability is 4.6% at the underwriter's optimal IPO price if s =0.07 and v = 0.5 [i.e., $F(y^*) = (\frac{s}{1+v}) = 0.046$], while the cumulative probability at the issuer's optimal IPO is 5% [i.e., F(X*) = .05].