Public Information and Cascades in IPOs: Evidence from Taiwan

Yenshan Hsu
Department of Finance
National Chengchi University
Taipei, Taiwan, ROC
Email: ysshiu@nccu.edu.tw
Tel: 886-2-29393091 ext. 81246

and

Cheng-Yi Shiu
Department of Finance
Chung Hua University
Hsinchu, Taiwan, ROC
Email: willy@chu.edu.tw
Tel: 886-3-5186537

This draft: May 21, 2004

We thank Y. Chris Liao, Paul Schultz, Ann Sherman, an anonymous referee, and seminar participants at National Chengchi University, National Chungcheng University, and at the 11th Conference on the Theories and Practices of Securities and Financial Markets for helpful comments and suggestions. We thank the Taiwan Securities Dealers Association for providing data on IPOs.

Public Information and Cascades in IPOs:
Evidence from Taiwan

Abstract

This paper examines information cascades in Taiwanese IPOs. We find that public information is the primary driver of a positive cascade. The evidence suggests that investors condition their demand for shares on public information, and issuers might also condition their going-public decisions on market conditions. Although private information affects IPO underpricing, the effect of public information on underpricing is even stronger, indicating that asymmetric information is not the primary driver of IPO underpricing. Rather, underpricing is attributable more to public than to private signals. Finally, we show that herding is more likely to occur in fixed-price offerings than in IPO auctions.

I. Introduction

Welch (1992) models the effect of information cascades on fixed-price selling procedures, assuming that investors are differently informed but more informed than issuers, and that once investors observe previous investors' actions they will update their valuation of the company. Issuers hence have to underprice issues in order to create a positive cascade. On the other hand, Benveniste and Busaba (1997) propose an alternative concept of information spillovers on that issuing firms can eliminate the threat of negative information cascades by releasing collective investors' private information to later investors.

We test both the implication of Welch's (1992) model on information cascades and Benveniste and Busaba's (1997) hypothesis of eliminating the threat of a negative cascade through information spillovers from earlier investors to later investors. For Taiwanese pure fixed-price offerings, we find a U-shaped distribution of allocation rates similar to that found by Amihud, Hauser, and Kirsh (2003); in other words, investors either overwhelmingly subscribe to new issues or avoid them, which is consistent with the information cascade model. The distribution of allocation rates is skewed to the left, so there is a considerable difference of positive and negative cascades.[1]

In a test of Benveniste and Busuba's (1997) hypothesis on Taiwanese hybrid offerings, where an auction precedes a follow-on fixed-price offer, we find that after observing information conveyed by earlier investors in IPO auctions, later investors indeed subscribe overwhelmingly to shares of follow-on fixed-price offerings, and they rarely refrain from subscribing.[2] The distribution pattern of allocation rates for follow-on fixed-price offerings is consistent with the implication in Benveniste and Busaba (1997) that the threat of a negative cascade can be eliminated.

A second objective is examination of the possible relationship between public information and investors' demand for shares. We analyze how much public information affects investors' demand for shares in an information cascade, or the influence of public information on the observed U-shaped distribution of our IPO sample.

[1] We define a positive cascade as an issue with an allocation rate of lower than 5%; a negative cascade with an allocation rate of greater than 95%; and an in-between issue with an allocation rate of between 5% and 95%.

[2] Benveniste and Busaba (1997) apply their model to the book-building process, but their argument is also applicable to IPO auctions, because what matters in their prediction is the information spillover *per se*, not the selling process. In addition, Benveniste and Wilhelm (1990) and Biais and Faugeron-Crouzet (2002) argue, assuming all information is endowed, that an auction is essentially equivalent to the book-building method with regard to its ability to convey information to investors.

We focus primarily on five public variables: industry factor, firm size, market index returns, initial returns of contemporaneous IPOs, and oversubscription of contemporaneous IPOs (i.e., the total demand for shares divided by total supply of shares). While the first four variables are motivated by previous research, as known to have an impact on underpricing, the last one is an extension of research on hot issue markets. Some researchers also view these variables as potential measures of investor sentiment.

First, behavioral theories posit that investors put too much weight on recent market results and trends. Market conditions will therefore have an impact on investors' demand for IPO shares. Second, individual investors in the IPO market tend to be swayed by fads, and small IPOs are more likely to be owned by individual investors. Finally, Ljungqvist, Nanda, and Singh (2001) argue that some investors might be irrationally exuberant about the prospects of IPOs in a particular industry.

We find that once we have separated the effects of public information from investors' demand for shares, as translated into investor subscriptions, the distribution of the residual allocation rates is skewed to the extreme right end of the U-shaped distribution (i.e., higher allocation rates), indicating that private signal is the primary driver of a negative cascade. The distribution of allocation rates induced by public information is skewed to the extreme left end of the U-shaped distribution (i.e., lower allocation rates), indicating that public information is the primary driver of a positive cascade. These two phenomena combine to create a U-shaped distribution of allocation rates.

We show that 25% to 45% of the variation in investor oversubscription can be predicted using public information known before the subscription date, suggesting that investors condition subscription on market conditions.

Our results also reflect the fact that most of our sample firms have gone public during favorable market conditions. We see that both market index returns and initial returns before the subscription date have a positive and significant influence on investor oversubscription. For most of our individual IPOs, the oversubscription ratio (i.e., the ratio of total demand to total supply of shares) attributed to these two market condition variables is greater than five. This is consistent with research of Ritter and Welch (2002), Schultz (2003), and Subrahmanyam and Titman (1999), who all predict that firms are more likely to go public during favorable market conditions.

Ritter and Welch (2002) argue that asymmetric information is not the primary driver of

IPO underpricing, and others have shown that public information has a very strong influence on IPO underpricing. We hence investigate whether it is public information or asymmetric information that has a stronger influence on IPO underpricing. Welch's (1992) model of information cascades predicts that positive cascades are likely to be more underpriced than negative cascades. We find that although a cascade dummy has a significant effect on the underpricing, the effect of public information on underpricing is even stronger. Moreover, the investor oversubscription that is induced by public information has a stronger influence on underpricing than does the oversubscription that is induced by asymmetric information, suggesting that asymmetric information is unlikely to be the primary driver of IPO underpricing.

Finally, for follow-on fixed-price offers of hybrid offerings, we see that public information also accounts for the lion's share of the variations in later investor subscriptions. This provides additional evidence that public information has a stronger influence on investor subscriptions to IPOs than does private information when it is incorporated into investor auction bids. In addition, we find that the distribution of allocation rates of IPO auctions exhibits a reverse U-shaped distribution, in striking contrast to the U-shaped distribution we see in fixed-price offerings. This striking difference indicates that herding is more likely to occur in fixed-price offerings than in IPO auctions.

We interpret the evidence as suggesting that investor characteristics are relevant to herding in IPO markets, for participants in our fixed-price offerings are exclusively individual investors, who are relatively homogeneous and uninformed, while participants in auctions include both institutional investors and individual investors who are relatively diverse. Some of these investors have better information, making herding less likely.

Not many authors have empirically examined the issue of information cascades in IPOs. The only exception, to our knowledge, is Amihud et al. (2003), who document evidence of information cascades in Israeli IPOs. We both document evidence of information cascades and identify the primary drivers of information cascades. Our overall results indicate, first, that a private signal is the primary driver of a negative cascade, and, second, a public signal is not only the primary driver of a positive cascade, but it also outweighs the private signal, resulting in a left-skewed U-shaped distribution of allocation rates.

The paper is organized as follows. Section II introduces the IPO selling procedures in Taiwan. In Section III we show data and summary statistics. Section IV presents the evidence of information cascades in pure fixed-price offerings and the evidence of information spillovers in sequential hybrid offerings. Section V examines the relation between public information and positive cascades. Section VI investigates the relation between information released from auctions and herding among investors in follow-on fixed-price offerings. Section VII concludes.

II. IPO Selling Procedures in Taiwan

Since December 1995, issuers in Taiwan have been able to adopt either a pure fixed-price method or a sequential hybrid procedure, where a discriminatory auction precedes the fixed-price method, to distribute IPO shares. The pure fixed-price method is valid for distributing either primary or secondary shares, while the sequential hybrid is valid only for distributing secondary shares.

In the pure fixed-price method, underwriters and issuers look at comparable firms and set issue prices according to a pricing formula prescribed by the Security and Futures Commission in Taiwan. Order sizes offered for subscription normally range from one to three lots (1,000 shares per lot). Institutional investors are eligible to subscribing to shares of fixed-price offers, but they are generally not interested in fixed-price offers because of constraints on order size. Never has an institutional investor in our IPO sample subscribed to shares of fixed-price offers. In the event of oversubscription occurs, underwriters adopt a lottery to allocate shares. The fixed-price offer will last about one calendar week, and the IPO date is two weeks later.

In the sequential hybrid procedure, an issuer will put 50% of IPO shares in an auction, and follow this with a fixed-price open offer to distribute the remaining shares, including shares not sold out in the auction. Before the start of the discriminatory auction, the underwriter and issuer announce the number of shares to be auctioned, the minimum acceptable price (i.e., the auction base price), and the initial price range for the offer price of follow-on fixed-price offers.[3] Each eligible investor can submit one or more price/quantity bids, just as in a sealed-bid auction, up to 3% of total IPO shares, i.e., 6% of auctioned shares. The submission period normally lasts one calendar week.

On the next business day following the auction closing date, the Taiwan Securities Dealers Association will then fill orders, starting with the higher bidding prices first until all

[3] Prior to 2000, the maximum price range that issuing firms were allowed to set was from the minimum acceptable price to 1.5 times the price; in 2000, the factor 1.5 was adjusted to 1.3. All our IPO sample firms set their possible price ranges corresponding to the maximum price ranges.

auctioned shares are distributed. Each winning bidder pays what it bids. The Association will then announce the price/quantity schedule for each individual winning bid, the identity of each winning bidder, and the offer price for the follow-on fixed-price offer.

The pricing rule for follow-on fixed-price offers is as follows: First, if there is oversubscription with an auction clearing price above the maximum price of the initial price range, the underwriter will then take the maximum price as the offer price for the follow-on fixed-price offering. Second, if there is oversubscription with an auction clearing price within the initial price range, the underwriter will first eliminate the winning bids with bidding prices above the initial price range, and then set the offer price at the quantity-weighted price calculated using the winning bids within the initial price range. Finally, if there is undersubscription, the underwriter will set the auction base price as the offer price for the follow-on fixed-price offering. We provide numerical examples of how the pricing rule operates in these three cases in the appendix.

The underwriter will conduct the follow-on fixed-price offer about three calendar weeks after the announcement of the auction results. The selling procedure is the same as in the pure fixed-price method.

Figure 1 depicts the timing of the sequential hybrid selling procedure.

Place Figure 1 about here

III. Data and Summary Statistics

We analyze 311 IPOs, 234 pure fixed-price offers and 77 hybrid offers, during the period from January 1996 through June 2000. This is the number of IPOs after excluding closed-end mutual funds and Taiwan Depository Receipts. We acquire the sample data through the Taiwan Securities Dealers Association.

Table 1 shows the distribution of our pure fixed-price and hybrid IPOs by year within our study period. Of the 234 pure fixed-price offers, 61 issues initially began trading on the Taiwan Stock Exchange and 173 issues on the over-the-counter market. Of the 77 hybrids, 44 initially began trading on the Taiwan Stock Exchange and 33 on the OTC market. In contrast to IPOs in Israel, fixed-price methods remain dominant for distributing IPO shares in Taiwan, although issuing firms can choose the auction process. Moreover, Israeli IPO auctions distribute all of the IPO shares, while Taiwanese IPO auctions are only one part (the first stage) of a sequential hybrid selling procedure to distribute 50% of IPO shares. The fixed-price methods (the second stage) distribute the remaining shares. Of the 234 pure fixed-price issues, 97 IPOs represent high-tech firms, while 137 issues are traditional firms. Of the 77 sequential hybrids, 41 issues are high-tech firms, while 36 issues are traditional firms. More firms of either type of firm are inclined to adopt the pure fixed-price procedure.

Place Table 1 about here

Table 2 presents the descriptive statistics for both samples of pure fixed-price IPOs (Panel A) and sequential hybrids (Panel B) by year. Of the 234 pure fixed-price offers, 27 issues are with an allocation rate (that is, the total supply divided by total demand) of greater than 0.95; most of them cluster in the year of 1996 and of 1999. On the other hand, 131 issues are with an allocation rate of less than 0.05; and most of them cluster in the year of 1999 and of 2000. Of the 77 follow-on fixed-price offers, 65 issues are with an allocation rate of less than 0.05, while only one issue is with an allocation rate of greater than 0.95.

Place Table 2 about here

We also see that larger issues are more apt to be distributed through the hybrid procedure, while smaller issues tend to be distributed through the fixed-price procedure. The average IPO proceeds in hybrid offerings are 1,073 million NT dollars, versus 433 million in pure fixed-price offerings.[4] A higher percentage of equity is also sold in hybrids rather than in pure fixed-price offerings. Pure fixed-price issuers have lower sales in the year preceding the IPO than do hybrids. These IPO characteristics are consistent with the prediction of Chemmanur and Liu (2002), who suggest that IPO auctions are the optimal choice for firms to sell a relatively high fraction of their equity and/or larger firms

On the other hand, the average age (that is, the number of years from the inception of a firm to its IPO year) is higher for pure fixed-price issues than that for hybrid issues. These results are not quite consistent with Chemmanur and Liu (2002), who predict that IPO auctions

[4] During the sample period, the exchange rate ranges from about 27 to 35 NT$/US$.

will be the optimal choice for older firms.[5]

The mean initial returns, benchmarked to the Taiwan Stock Exchange value-weighted index, are 21.64% and 22.72% for pure fixed-price offerings and sequential hybrids, respectively.[6]

IV. Information Cascades and Spillovers

Welch (1992) models the effect of information cascades on fixed-price issues assuming that investors attempt to evaluate the interest of other investors, and that later investors, having observed the actions of earlier investors, will make the same choices as to staying out of the market or subscribing, regardless of their private information. Hence, pricing an issue just a little too high or too low will give the issuer too high a probability of complete failure or complete success; in other words, investors will either subscribe overwhelmingly to shares or largely ignore them. We test the implication of Welch's (1992) model of information cascades using our sample of 234 pure fixed-price offerings.[7]

Panel A of Figure 2 is a histogram of the allocation rates for the 234 pure fixed-price offerings. The distribution pattern reveals that of 234 IPOs, 130 have an allocation rate of lower than 5%; in other words, investors subscribe aggressively to shares of these issues. Another 37 IPOs have an allocation rate falling between 5% and 15%; most investors also subscribe aggressively to shares of these issues, but to less of a degree. At the other end of the scale, 27 IPOs have an allocation rate of higher than 95%; in these cases, most investors stay away.

Place Figure 2 about here

The distribution of allocation rates with only a few issues in between is similar to the finding of Amihud et al. (2003). Our results are hence consistent with the implication of Welch's (1992) model of information cascades.

[5] This calls for some caution in interpreting our evidence. Chemmanur and Liu (2002) model their predictions based on uniform-price auctions rather than based on discriminatory auctions. Moreover, some firms in our sample might not act optimally in choosing the selling procedure.

[6] The return data are retrieved from the data bank of the Taiwan Economic Journal; the stock markets in Taiwan impose a daily price limit of 7% on securities traded in the markets; a security's price may therefore continue to hit the limit several days after the listing. The initial return reported here is the cumulative market-adjusted return until the day the limit is not hit.

[7] Amihud et al. (2003) include both fixed-price offerings and auctions in their study. We include only fixed-price offerings in order to be consistent with Welch's (1992) model, which assumes the fixed-price procedure is the IPO selling method.

Panel B of Figure 2 is a histogram of allocation rates for the 77 follow-on fixed-price offerings. Of 77 offerings, 65 have an allocation rate of lower than 5%, and only one offering has an allocation rate of higher than 95%.[8] This indicates that auctions create information spillover for follow-on fixed-price offerings, suggesting that underwriters and issuing firms can avoid the threat of negative cascades by gathering earlier investors' private information and releasing it to later investors. The distribution of allocation rates for these follow-on fixed-price offerings is consistent with the implication of Benveniste and Busaba's (1997) model of information spillovers.

Even though the sequential hybrid procedure enables issuers to eliminate the threat of negative cascades, the fixed-price procedure is still the dominant IPO selling method in Taiwan. Because there is such a difference between the numbers of fixed-price offerings (234 IPOs) and sequential hybrids (77 IPOs), we have to ask why issuing firms prefer the fixed-price procedure to the sequential hybrid procedure.

Four possible reasons may explain this phenomenon. First, Welch (1992) argues that if issuers are highly risk-averse, they can do better by pricing low enough to create an information cascade immediately, rather than adjust the offering price in response to sales. Sherman (2003) shows that there are problems with discriminatory IPO auctions, including variation in the number of bidders and volatility in aftermarket trading. Therefore, highly risk-averse issuers may opt for the fixed-price method. Benveniste and Busaba (1997) also reach a similar conclusion that firms with greater concern for risk are also more likely to prefer a fixed price offering.

The second reason for the use of fixed-price offering is that issuers of primary shares cannot help but choose the pure fixed-price method. Of the 234 pure fixed-price offerings in our IPO sample, though, only three IPOs are associated with primary shares. Primary shares therefore cannot explain why most issuing firms adopt the pure fixed-price method to distribute IPO shares.

Third, the time between the auction and the follow-on fixed-price offering imposes additional market risk on issuers. If issuers cannot tolerate additional market risk, they will prefer a fixed-price offering. In addition, the delay between the auction and IPO date is longer

[8] The failed issue is Sinyi Realty. Investors avoided the first-stage auction for this issue. According to the explicit pricing rule, the issuer must take the initial base price in the auction as the offer price for the follow-on fixed-price offering. The inability by Sinyi Realty to price the issue below the initial base price led to the failure of its follow-on fixed-price offering.

than the delay between the fixed-price offering and IPO date. Investors will therefore expose themselves to market risk more in auctions than in fixed-price offerings. Investors hence are more likely to hold back in auctions, increasing the probability of failure at auction. A shortened time lapse would definitely give issuers incentives to adopt the sequential hybrid procedure.

Finally, according to the prespecified pricing rule, issuing firms are unable to incorporate all the information from the auction in setting their offer prices. For instance, issuers of even highly sought after issues are unable to price these issues above the initial price range, so they leave more money on the table. Table 1 indicates that sequential hybrids are more underpriced than the pure fixed-price offerings. This might be attributable to the rigid pricing rule according to which issuers set the offer price of their follow-on fixed-price offerings. Issuers of unwanted issues similarly cannot price these issues below the price range, so they expose themselves to the possibility of a negative cascade. Auction procedures such as the French *offre à prix minimal* that give more price discretion to issuers are more competitive with fixed-price offerings.[9]

V. Public Information and Information Cascades

Benveniste, Busaba, and Wilhelm (2002) theorize that when a firm goes public, it produces information spillovers. The information produced is valuable to firms planning to go public. Draho (2001), on the other hand, argues that public information generated by previous IPOs creates incentives for investors, and their actions increase the probability that an IPO will be desirable.

In other words, investors may condition their decisions to purchase on public information, and the influential role of public information in hot market IPOs implies that something similar to an information cascade is at work. We thus investigate the relationship between public information and herding among investors.

A. Public information variables

We examine three types of public information: firm characteristics, stock market conditions, and demand/pricing of other contemporaneous IPOs in our sample period. For firm

[9] In the French *offre à prix minimal*, issuers and underwriters negotiate with the market authority to choose the offer price. Bias, Bossaert, and Rochet (2002) show theoretically and Derrien and Womack (2003) empirically that the French *offre à prix minimal* is an optimal selling procedure.

characteristics we include *Ln_sale*, which is equal to the natural logarithm of the yearly sales preceding the IPO year, to proxy for the size of a firm, and *Hi_tech*, which is a dummy variable equal to 1 if the firm is a high-tech firm, and 0 otherwise.

We follow Derrien and Womack (2003) to construct a series of market index returns to capture stock market conditions. For each individual offering, we construct a three-month weighted market index return variable as a weighted average of the buy-and-hold returns of the Taiwan Stock Exchange value-weighted index in the three months before the subscription's beginning date. The weights are three for the most recent month, two for the next, and one for the third month before the subscription's beginning date. We then divide this weighted sum by six to get a weighted monthly market return.

We next examine the oversubscription of and the initial return of other contemporaneous IPOs. Similarly, we construct a three-month weighted variable of oversubscription, defined as the total demand of shares divided by total supply of shares. For each individual offering, we first calculate the monthly (arithmetic) average oversubscription of other contemporaneous IPOs for each of the three months before the subscription's beginning date. A three-month weighted oversubscription variable is then constructed as a weighted average of the calculated monthly oversubscriptions in the three months before the subscription's beginning date. The weights are three for the most recent month, two for the next, and one for the third month before the subscription beginning date. We also divide the weighted sum to get a weighted monthly oversubscription.

Similarly, for each individual offering we construct a three-month weighted initial return variable, which is the weighted average of monthly arithmetic initial returns of other contemporaneous IPOs in the three months before the subscription's beginning date.

Table 3 presents the summary statistics for the public information variables. The mean market index return before the subscription period is 2.64% for pure fixed-price offerings and 0.46% for follow-on fixed-price offerings. This considerable difference (and a higher standard deviation for the hybrid offerings) indicates that the added time for conducting follow-on fixed-price offerings might impose additional market risks on issuers adopting the hybrid method.

Place Table 3 about here

The mean oversubscription of other contemporaneous IPOs is 58.57 for pure fixed-price offerings and 81.12 for follow-on fixed-price offerings. The follow-on fixed-price offerings on average attract more investor subscriptions than the pure ones. Finally, the mean initial return of other contemporaneous IPOs is 18.30% for pure fixed-price offerings and 19.03% for follow-on ones, not very different.

B. Public information and positive cascades

We use three variables to measure whether public information has a role in the U-shaped distribution of allocation: *Ln_os*, *Ir_cipo*, and *Mkt_rtn*. *Ln_os* is the natural logarithm of the oversubscription of other contemporaneous IPOs; *Ir_cipo* is the initial return of other contemporaneous IPOs; and *Mkt_rtn* is the market index return prior to the subscription period. We also include the firm characteristic variables: *Ln_sale* and *Hi_tech*. *Ln_sale* is the natural logarithm of the yearly sales preceding the IPO year, and *Hi_tech* is a dummy variable equal to 1 if the firm is a high-tech firm, and 0 otherwise.

Table 4 shows results of the analysis that relates investors' oversubscription (actually the logarithm of oversubscription) of pure fixed-price offerings to the public information variables. Regression 1 in Table 4 shows that the coefficient of *Mkt_rtn* is positive and very significantly different from zero. The regression has an adjusted R-squared of over 20%, indicating that the market index return variable has a very strong influence on investors' decision to subscribe to IPO shares.

Place Table 4 about here

In Regression 2 we observe a similar result for the oversubscription variable (*Ln_os*); the coefficient of *Ln_os* is positive and significant, but to a lesser degree. This regression has an adjusted R-squared of over 17%.

Regression 4 also shows a similar result for the initial return variable (*Ir_cipo*). The coefficient of *Ir_cipo* is positive and significant. The adjusted R-squared is 16.98%.[10]

The evidence suggests that any one of the three public information variables (*Mkt_rtn*, *Ln_os*, and *Ir_cipo*) has a strong influence on investor decisions to subscribe to IPO shares. In Regression 5 we hence simultaneously regress the three public information variables on investor oversubscription. The result shows that the market index return variable has the strongest

[10] In these regressions, we model the interplay of the information variables on investors' oversubscription as multiplicative rather than additive.

influence, but the initial return variable becomes insignificant, suggesting that the market index return variable and the oversubscription variable account for the effect of the initial return variable on investor demand for shares.

In Regression 6 we add the firm characteristic variables, size and industry. The coefficient of industry dummy is positive and significant, while the coefficient of the size variable is negative, but insignificant. These results are similar to the findings of Cornelli and Goldreich (2003), who report that oversubscription is significantly higher for a high-tech firm, and oversubscription is not significantly related to the size of a firm.

Our results overall reveal that the public information variables together account for greater than 47% of the variation of investor subscription. This immediately presents a conjecture that public information is the primary driver of the positive cascades.

To examine this conjecture, we first separate allocation rates into two parts: one part based on public information and the other based on private information and other factors. We then use the fitted values and the residuals derived from the regressions in Table 4 to capture the portion of oversubscription based on public information and the portion based on private information and other factors.

Table 5 presents the summary statistics for the fitted and residual allocation rates (i.e., the reciprocal of oversubscriptions) for the Table 4 regressions. The results show that the mean allocation rate based on public information ranges from 0.07 to 0.12, while the mean allocation rate based on private information and other factors ranges from 3.70 to 8.00. The evidence suggests that public information indeed induces a lot of investors to subscribe to IPO shares; in other words, the positive cascades can be attributed to the public information.

Place Table 5 about here

To provide further evidence on this, in Panel A of Figure 3 we plot the histogram of 234 fitted allocation rates according to Regression 5 in Table 4. Of the 234 IPOs, 108 have a fitted allocation rate of lower than 5%; in other words, public information has a very strong influence on the oversubscription of these issues. Of the 234 IPOs, 76 have a fitted allocation rate falling between 5% and 15%; public information also has a strong impact on the oversubscription of these issues, but to a lesser degree. Finally, all 234 IPOs have a fitted allocation rate of lower than 45%, reflecting that public information indeed plays a very important role in investors' decisions to subscribe to IPO shares. Results from the other regressions in Table 4 show a similar distribution pattern of fitted allocation rates.

Place Figure 3 about here

Panel B of Figure 3 is a histogram of residual allocation rates according to Regression 5 in Table 4. The distribution pattern of residual allocation rates is very different from the pattern of fitted allocation rates. Of the 234 IPOs, 96 have an allocation rate of higher than 95%, while only four IPOs have an allocation rate of lower than 5%. The evidence indicates that private information is not the primary driver of a positive cascade, but rather the primary driver of a negative cascade. Results from the other regressions in Table 4 show a similar distribution pattern of residual allocation rates.

Panel A of Figure 2 indicates that of the 234 IPOs, only 27 have an allocation rate of higher than 95%; in Panel B of Figure 3, however, we find that 96 IPOs have a residual allocation rate of higher than 95%, suggesting that the investor demand for shares that is induced by public information has helped 69 issuing firms avoid the threat of a negative information cascade. On the other hand, in Panel A of Figure 2, we find that 130 IPOs have an allocation rate of lower than 5%, while in Panel B of Figure 3 only four IPOs have an allocation rate of lower than 5%. This evidence reflects that public information has helped 126 IPOs achieve a positive information cascade. The overall evidence suggests that public information outweighs the effect of private information in influencing investors' decisions to subscribe to IPO shares.

To provide further evidence, we focus differences in underpricing for different groups of IPOs. We first examine the 96 IPOs with a residual allocation rate of more than 95%; of these 96 IPOs, 27 eventually experience a negative information cascade (that is, an allocation rate of higher than 95%), while the other 69 IPOs avoid the negative cascade.[11] Suppose that these 96 IPOs were originally poorer-quality issues according to investors' private valuations, and that the market prices of these issues adjust to their true values when trading commences; there should be no significant differences in underpricing between the 27 negative cascade issues and the 69 in-between issues if it is public information that enables the latter to avoid a negative cascade. The results are in Table 6.

[11] These issues are not included in positive cascades; that is, they belong to in-between issues.

Place Table 6 about here

In Table 6, as in Table 4, we use three types of explanatory variables. First, we use a set of firm characteristic control variables, such as the size of a firm (*Ln_sale*) and the industry factor (*Hi_tech*). Recent IPO research has documented that these firm characteristic variables affect the aftermarket return of an offering. Second, we use the market index return variable (*Mkt_rtn*) to reflect recent secondary market conditions. Finally, we use the initial return variable (*Ir_cipo*) to reflect recent IPO market conditions. In Table 6, we calculate these public information variables as of the IPO date (instead of the earlier subscription date as before) to account for the impact of public information on IPO underpricing.

We measure the underpricing difference between these two groups of issues (27 issues versus 69 issues) by the negative cascade dummy. The NC dummy in Table 6 (column 1) is negative and statistically significant when examined independently. After we include control variables in the regression, the difference in underpricing (column 2) is negative, but becomes insignificant. That is, the negative cascade issues on average are not more underpriced than the 69 in-between issues. Both the industry variable and the market index return variable, on the other hand, have a significant and positive impact on underpricing.

When the regression is conditioned on the market index returns or initial returns of other contemporaneous IPOs (column 3), neither the market index return variable nor the initial return variable has a significant impact on the underpricing of negative cascades. The market index return variable, however, does have a significant and positive impact on the underpricing of in-between issues (the nonnegative cascade dummy: NNC). This indicates that the underpricing difference between negative cascades and in-between issues is attributable more to public than to private information.

C. Public information, asymmetric information, and underpricing

Is it public information or asymmetric information that is the primary driver of IPO underpricing? Ritter and Welch (2002) argue that asymmetric information is unlikely to be the primary driver of IPO underpricing, and other studies have shown that public information has a very strong influence on IPO underpricing. These results hence challenge asymmetric information as the primary driver of IPO underpricing. Welch (1992, theorem 5, p. 707) states that the expected IPO underpricing is between 0% and 50% for successful offerings, which can ex-post be either underpriced or overpriced.

If we deem positive cascades as successful issues and negative cascades as unsuccessful ones, and if earlier investors approached with a random signal of either H (a high valuation on the issue) or L (a low valuation on the issue), then issues realizing a positive cascade should, on average, be more underpriced than issues realizing a negative cascade. In other words, if asymmetric information underlying Welch's model is the primary driver of underpricing, then the cascade dummy should have a stronger influence than public information on the underpricing. These tests are in Table 7.

Place Table 7 about here

In Table 7, we use the same three types of explanatory variables: firm characteristic variables, a market index return variable, and the initial return variable. Regression 1 in Table 7 shows that the underpricing difference between negative cascade issues and positive cascade issues (27 issues versus 130 issues, measured by the negative cascade dummy (NC)) is negative and statistically significant when examined independently.

After we include the control variables in regression 2, the underpricing difference is still negative and statistically significant. That is, positive cascade issues are on average more underpriced than negative cascade issues. In regression 3, conditioned either on the market index return or on the initial return, neither variable has a significant impact on the underpricing of negative cascade issues, but the market index return variable does have a significant and positive impact on the underpricing of positive cascade issues (positive cascade dummy: PC). Although the cascade dummy has a significant effect on the IPO underpricing, the effect of either the industry factor or the market index returns is even stronger, suggesting that asymmetric information is unlikely to be the primary driver of IPO underpricing.[12]

Cornelli and Goldreich (2003) document that oversubscription predicts returns, suggesting that oversubscription in an IPO does help to value the issue correctly. They also find that when they introduce oversubscription, the issue price relative to the initial price range becomes insignificant in predicting initial returns. In other words, oversubscription embodies

[12] When we group both positive cascade issues and in-between issues as the successful issues, and negative cascade issues as the unsuccessful ones, the underpricing difference between successful issues and unsuccessful issues then becomes insignificant.

more information, both public and private, than what the underwriter has incorporated in setting the issue price.

To further verify whether asymmetric information is the primary driver of IPO underpricing, for each IPO, we would like to extract both public information and private information from the oversubscription of individual IPOs. We use regression 5 of Table 4 for fitted and residual oversubscription values to proxy for public information and private information. We then investigate the relation between initial returns, where the fitted oversubscription serves as the public information variable and the residual oversubscription serves as the asymmetric information variable.

The result relates the initial return to the fitted oversubscription (*Fit_os*), the residual oversubscription (*Res_os*), the size of a firm (*Ln_sale*), and the high-tech dummy (*Hi_tech*) (t-statistics in parentheses):

$$\text{Initial Return}_i = \underset{(0.70)}{15.6002} + \underset{(2.04)}{7.7623}\, Hi\_tech_i - \underset{(-1.68)}{2.5118}\, Ln\_sale_i + \underset{(8.65)}{13.4333}\, Fit\_os_i + \underset{(7.33)}{8.0297}\, Res\_os_i$$

Adjusted $R^2 = 0.4510$

The results show that while the residual oversubscription predicts returns, the effect of fitted oversubscription on returns is even stronger. For each 1 percentage point increase in the fitted oversubscription, there is about a 13% increase in initial returns, while each 1 percentage point increase in the residual oversubscription is accompanied by only an 8% increase in initial returns, suggesting that asymmetric information is unlikely to be the primary driver of IPO underpricing.

D. Discussion

Theories based on asymmetric information have long been the principal explanation of IPO underpricing. More recently, authors such as Bradley and Jordan (2002), Derrien and Womack (2003), Loughran and Ritter (2002), and Lowry and Schwert (2004) have found that a huge amount of the variation in IPO underpricing is predictable using available public information, such as market returns, an industry factor, and the initial returns of other contemporaneous IPOs. Ritter and Welch (2002) hence argue that asymmetric information is not the primary driver of IPO underpricing.

We have now shown that while positive cascades are more underpriced than negative ones, market conditions have an even stronger influence on underpricing. Moreover, investor oversubscription induced by market conditions has a stronger influence on underpricing than does investor oversubscription induced by asymmetric information. We would interpret this result as assurance that asymmetric information is not the primary driver of IPO underpricing, although it is not proof that public information is the primary driver of underpricing.

Welch's (1992) model of information cascades assumes that investors are differently informed, even though they are more informed than issuers, and that investors who have observed previous investor actions will update their valuations of a company. Issuers hence have to underprice issues in order to create a positive information cascade.

One requirement for such an information cascade, as Daniel (2002) argues, is that later investors believe earlier investors actually have significant private information. The evidence from our IPO sample, however, reveals that not only is the public signal a primary driver of positive cascades, but during hot markets it also outweighs the private signal, which is the primary driver of negative cascades. Our results are therefore not quite consistent with Welch's (1992) model, which presumably assumes that private information is the primary driver of an information cascade but that public information has no role in driving an information cascade.

A remarkable result is that not only is the public signal a primary driver of a positive cascade, but it also dampens the private signal. This result is consistent with the suggestion of Draho (2001), who posits that public information serves as a coordinating device, because investors use it to form beliefs about the beliefs of other investors, and they will condition subscription decisions on their beliefs about other investors' demands. When public information becomes more favorable, investors are more willing to subscribe to issues even with poor fundamentals. Hence, these issues with poor fundamentals can be quite successful during a hot market, but they might fail in normal market conditions.

Although we are unable to distinguish whether later investors have observed public information directly from the markets or indirectly from other investors or from both, the overall evidence suggests that investors probably condition their demand for IPO shares on public information. This deduction would not be unreasonable if we assume investors will flip received shares in the aftermarket. In hot markets, it is easier to flip received shares, as buying is aggressive in the aftermarket, and investors are more willing to subscribe to IPO shares. In depressed markets, investor demand will decline in the aftermarket, and it becomes more difficult to flip shares; investors are hence more likely to retreat from the IPO markets. Aggarwal (2003) finds that flipping by investors is much higher for hot IPOs (IPOs with the highest initial returns) than for cold IPOs (IPOs with the lowest initial returns), which is consistent with our deduction.

Our evidence indicates that while positive cascades are on average more underpriced than negative ones, public information has an even stronger influence on the underpricing of positive cascades; moreover, the variable of market index returns has the strongest influence on the underpricing of positive cascades, while its effect on the underpricing of negative cascades is insignificant. This reflects that when market returns are high, investors are willing to overpay in the aftermarket, making it easier to flip shares. When market returns are low, investors will not overpay in the aftermarket, making it harder to flip shares. Market conditions will therefore have an impact on investor demand for IPO shares.

Another behavioral explanation of why investors might condition IPO subscription on market conditions is the prospect theory of Kahneman and Tversky (1979), which Loughran and Ritter (2002) use to explain the phenomenon of partial adjustment to public information, and the reason why issuers do not get upset about leaving money on the table. The idea that people care about changes in financial wealth and that they are loss-averse as to changes is a central feature of prospect theory. The house money effect of Thaler and Johnson (1990) and the biased self-attribution theory of Daniel et al. (1998) predict that investors will become less loss-averse or more confident as they achieve a previous gain in the stock market or on previous IPOs, and therefore will demand more of the stock; however, if they have recently experienced painful losses in the market, then they might become more loss-averse. This explains why market index returns and initial returns of other contemporaneous IPOs have a very strong and positive influence on investor demand for IPO shares.

Our results show there is a considerable difference in numbers of positive and negative cascades (130 versus 27 in Panel A of Figure 2), suggesting that issuing firms are more likely to delay or withdraw an issue in a depressed market than in a hot market, which results in fewer negative cascades. The evidence is consistent with Lerner (1994), who, using a sample of privately held venture-backed biotechnology firms, shows that these companies go public when market equity valuations are high and employ private financing when valuations are low.

Our results are consistent with arguments in Draho (2000) and Daniel (2002), who treat the going-public decision as a real option. They argue that taking the choice of going public is equivalent to exercising the option to wait, which is viewed as the cost of undertaking an IPO. The issuing firms view hot IPO markets as a particularly good time to issue, likely because the prices are particularly high. This means that the cost of waiting (or delaying) would be too great in a hot market; in a cold market, the cost of waiting (or delaying) is lower. They hence conclude that IPOs should be more likely to occur in an up market than in a down market.

Our results are also consistent with the implication of Schultz (2003) and Subrahmanyam and Titman (1999), who posit that markets provide valuable public information to issuers, who take advantage of increased growth opportunities that are signaled by higher prices of firms in the market. Firms are hence more likely to go public during favorable market conditions. The semi-rational theory posited by Ritter and Welch (2002) also predicts that firms are more inclined to go public after valuations in the public markets have increased.

VI. Herding in Follow-on Fixed-Price Offerings

Given that public information accounts for the lion's share of investor demand for shares, we might ask whether the incorporated public information or the embedded private information in auctions has a stronger influence on the herding among investors in follow-on fixed-price offerings. In other words, is public information or private information the primary driver of investor demand for shares of follow-on offerings?

To answer this question, we conduct a simple test on follow-on fixed-price offerings.

A. Publicized information from the auction

Prior to the conduction of follow-on fixed-price offers, the Taiwan Securities Dealer Association releases some information collected from the auction to the public. The information usually includes the quantity-weighted average bidding price for winning bids, the auction clearing price, the open offer price, the demand schedule of winning bids, the identity of winning bidders, the overall oversubscription ratio, the number of bids, and the number of shares (or dollar amount) allocated as well as the bidding price of each winning bid.

The publicized information includes not only public information available prior to the auction period, but also auction bidders' private information; later investors hence evaluate the released information and decide whether to subscribe to shares of follow-on fixed-price offerings.

We abstract some information variables from the released information as follows. First, we use the price-relevant information from investors' bids. Following the spirit of Cornelli and Goldreich (2003), we normalize the quantity-weighted bidding price for winning bids relative to the possible price range of follow-on fixed-price offering.

Formally, the normalized quantity-weighted bidding price (henceforth NQWP) for winning bids is equal to (Pw – Pmin)/(Pmax – Pmin); Pw is the quantity-weighted bidding prices for winning bids; and Pmax and Pmin are, respectively, the maximum and minimum of the initial price range set by the underwriter.[13] The normalized bidding price is above one when the quantity-weighted bidding price is above the maximum of the initial price range.

This normalization procedure adjusts for the price range. The difference between the quantity-weighted bidding price and the minimum price is large when the range is narrow, but small when the range is broad. When the NQWP is high, information reveals that the offering is a good one or that the issuer sets a lower minimum price as insurance, so later investors will aggressively subscribe to shares.

Second, we abstract the quantity-relevant information from investor bids. We capture the quantity-relevant information with the measure of oversubscription (actually the logarithms of oversubscription) as well as the number of bids (also the logarithms of the number of bids). Particularly, we focus on oversubscription corresponding to all bids, measured at a price equal to the lowest bidding price. When oversubscription is high, information reveals that an offering is a good one. Similarly, when there are many bids, information also reveals that the offering is a good one; later investors will seek shares of the offering.

Table 8 reports the summary statistics for NQWP, oversubscription from the auction, and number of bids. On average, the NQWP for winning bids is 1.56 (the median is 1.28), reflecting that the initial price range specified by underwriters is relatively low compared to the market's pre-auction expectation of the issue value.

Place Table 8 about here

The mean oversubscription is 3.94 (the median is 3.30), with a range of between 17.20 and 0.39. This fact reflects that some auctions have a very successful result while a few fail.

[13] The average Pmax and Pmin difference for our hybrid auctions is set at NT$22 while the median of the difference is NT$17.

The mean number of bids is 987 (the median is 645), with a range between 5,406 and 39.

B. Publicized information and herding

We next analyze the fixed-price subscription following the auction for 77 hybrid IPOs in detail. The released information incorporates not only the public information that was generated before the auction period, but also the investor private information revealed in auctions. To investigate whether public information is the primary driver of investors' demand for shares, we first abstract the element of public information from investor bids in auctions. As in Table 3, we use the market index return variable (*Mkt_rtn*) and the initial return variable (*Ir_cipo*) to reflect the market conditions, but we here calculate these two public information variables as of the auction's beginning date. We also use the industry factor (*Hi_tech*) and the size of a firm (*Ln_sale*) to capture information on firm characteristics.

We regress the NQWP, the natural logarithm of oversubscription (*Ln_os*), and the natural logarithm of number of bids (*Ln_nob*) on the public information variables: the market index return prior to the auction period, the initial return of other contemporaneous IPOs, the high-tech dummy, and the size of a firm.

Table 9 presents the regression results, showing that investors indeed incorporate public information into their bids. Regression 1 indicates that both *Ir_cipo* and *Hi_tech* have a positive and significant impact on investors' bidding prices of winning bids, suggesting that participants offer higher prices in hot issue markets and for high-tech firms; *Ln_sale* has a negative and significant impact on investors' bidding prices, suggesting that investors submit lower bids for larger firms.

Place Table 9 about here

Regression 2 in Table 9 shows that the initial return variable has a very strong influence on the oversubscription of auctions. What is contrary to our expectation is that neither the market index return nor the high-tech dummy has a significant impact on investor oversubscription at auctions. This result is contrary to our earlier finding on investors' oversubscription of pure fixed-price offerings that the market index return and the high-tech dummy have a positive and significant impact (Reg6, Table 4). In other words, the fixed-price offerings and auctions reflect a different relationship between oversubscription and public information.

We posit that the insignificance of the market index return variable and of the high-tech dummy might be attributable to the participation of institutional investors and large individual investors in IPO auctions. Aggarwal, Prabhala, and Puri (2002) show that institutional investors have better information than retail investors, while Lee, Taylor, and Walter (1999) provide evidence that large investors have better information than small investors. Better-informed investors are in a better position at auction than uninformed investors, and they will definitely condition subscriptions on their private information. If informed investors are planning to flip their shares in the aftermarket, the public information on which they condition this action might be the initial returns of other contemporaneous IPOs, rather than market index returns and firm characteristics. The fact that institutional investors and large investors have an active role in Taiwanese IPO auctions presumably dilutes the influence of uninformed investors, resulting in an insignificant relationship between market index returns and oversubscription of auctions.

Another reason for the insignificant relationship between the market return and oversubscription of an auction is that in an auction the price is not set ahead of time, and the market return therefore may be less important. On the contrary, in a fixed-price offering the price is already set, and changes in the market return will therefore have influenced investors' subscriptions.

To further investigate the influence of institutional investors and large investors on the oversubscription of auctions, we plot the histogram of allocation rates for 77 IPO auctions in Figure 4. The distribution surprisingly exhibits an almost reverse U-shaped distribution, in striking contrast to the U-shaped distribution of allocation rates we have observed in pure fixed-price offerings. We interpret this evidence as suggesting that herding is more likely to occur in fixed-price offerings, where investors are relatively homogeneous and uninformed, than in auctions, where investors are relatively diverse and some have better information than others. Participants in our fixed-price offerings are exclusively individual investors, who are more subject to fads according to Lee, Shleifer, and Thaler (1991). In other words, investor characteristics are relevant to herding in IPO markets.

Place Figure 4 about here

Selling methods may be another important explanation for the presence of herding in

IPOs. Amihud et al. (2003) demonstrate that the distribution of allocation rates for 245 Israeli uniform-price auctions exhibits a U-shaped pattern.[14] In discriminatory auctions, the winning bidders pay what they bid, and because the uninformed do not have any information advantage, they might not participate in the IPO market so as to avoid the "winner's curse." In either fixed-price offerings or uniform-price auctions, all winning bidders pay the same offer price, reducing the threat of the winner's curse, and they become more aggressive in subscribing to IPO shares. Our evidence is consistent with Chowdhry and Sherman (1996), who presents a theoretical model on the relationship between oversubscription and selling methods, and they conclude that extreme levels of oversubscription are more likely to occur in fixed-price offerings.

Another explanation of why investors avoid Taiwanese auctions is a longer delay between the auction and the IPO date than between the fixed-price offering and the IPO date. Investors therefore expose themselves to more market risk in auctions than in fixed-price offerings.

Regression 3 in Table 9 shows that both *Mkt_rtn* and *Ir_cipo* have a positive and significant impact on the number of bids; this result is somewhat different from what is reported in Regression 2, where only *Ir_cipo* is significantly related to oversubscription. The underlying reason for the difference is that an oversubscription in auctions is equivalent to the quantity-weighted number of bids, where institutional bids and large bids are assigned a greater weight as they demand more shares. In the case of the number of bids, each individual bid is assigned an equal weight, and institutional investors and large investors are hence dominated by retail investors and small investors, who condition their subscriptions on the market index returns, resulting in a significant relation between number of bids and market index returns.

As in Table 5 we use the fitted values and the residuals from regressions in Table 9 to capture public information and private information, respectively. In Table 10 we present the results of an analysis that relates the oversubscription of follow-on fixed-price offers to NQWP, *Ln_os*, and *Ln_nob*.

Place Table 10 about here

[14] Amihud et al.'s report includes 37 fixed-price offerings and 245 uniform-price auctions. Of their 282 IPOs, 142 IPOs have an allocation rate of lower than 5% and 73 have an allocation rate of over 95%. Therefore, excluding the 37 fixed-price offerings from their IPO sample will not drastically change the U-shaped distribution of allocation rates; in other words, the distribution of allocation rates for 245 uniform-price auctions should also exhibit a similar U-shaped pattern.

Regression 1 in Table 10 shows that coefficients for the variables of *Ln_os* (t-statistic = 3.02), NQWP (t-statistic = 2.70), and *Ln_nob* (t-statistic = 3.41) are all positive and very significantly different from zero. This regression has an adjusted R-squared of over 59%, indicating that information released from the auction indeed has a very strong influence on investor demand for shares of follow-on fixed-price offerings.

In order to verify whether public information has a stronger influence than does private information on investors' demand for shares of follow-on fixed-price offerings, we regress the oversubscription on the fitted values of and on the residuals of NQWP, *Ln_os*, and *Ln_nob*, respectively. Regression 2 relates the oversubscription of follow-on fixed-price offerings to the fitted values; this regression has an adjusted R-squared of over 40%, but none of the coefficients have t-values exceeding 2.0, suggesting an apparent collinearity.

Because the fitted values of *Ln_os* and of *Ln_nob* are highly correlated, we exclude the fitted values of *Ln_nob* and rerun the regression. Regression 3 shows the results; this regression has an adjusted R-squared of over 41%, and the coefficient of the fitted *Ln_os* is significant, but the coefficient of NQWP is not. The results suggest that when later investors subscribe to shares of subsequent offerings, they condition their purchase decisions more on earlier investor actions than on the revealed value of IPO shares.

Regression 4 relates the oversubscription of follow-on fixed-price offerings to the residuals of NQWP, *Ln_os*, and *Ln_nob*; this regression has an adjusted R-squared of above 19%, and there also is an apparent collinearity. We hence rerun the regression by excluding the residuals of *Ln_nob*. Regression 5, similar to Regression 3, shows that the coefficient of residual oversubscription is significant, but the coefficient of NQWP is not. This regression has an adjusted R-squared of 17.26%, suggesting that public information predicts much more of the variation of investors' demand for shares than does private information.

VII. Conclusion

Our examination of information cascades in IPOs indicates that for Taiwanese fixed-price offerings the distribution of allocation rates exhibits a U-shaped distribution as implied by Welch (1992). Further evidence indicates that while the private signal is the primary driver of a negative cascade, the public signal is not only the primary driver of a positive cascade, but also outweighs the private signal. These results are not quite consistent with Welch's (1992) model, which posits that asymmetric information is the primary driver of an information cascade.

Instead, the results are consistent with Draho (2001), who argues that public information acts as a coordinating device, because investors use it to form beliefs about the beliefs of other investors. Investors then will condition subscription decisions on their beliefs of other investors' demands, hence creating an information cascade. In addition, we propose two explanations, flipping and the prospect theory, of why investors condition their subscriptions on market conditions. Finally, changes in market conditions influence investor subscription decisions since the prices have already been set in fixed-price offerings.

When we investigate whether asymmetric information is the primary driver of IPO underpricing, we find that the cascade dummy has a significant effect on the underpricing, but the effect of public information is even stronger. In short, we can rely on the evidence for assurance that asymmetric information is not the primary driver of IPO underpricing, even though not proof that public information is the primary driver of underpricing.

We also examine Benveniste and Busaba's (1997) hypothesis of eliminating negative cascades through information spillovers. The distribution of allocation rates on follow-on fixed-price offerings suggests that information spills over from auctions to follow-on fixed-price offers. The evidence that most firms in our sequential hybrids have achieved a positive information cascade in follow-on fixed-price offers is consistent with Benveniste and Busaba (1997), who argue that information spillovers enable issuers to avoid the threat of a negative information cascade.

We also find that public information that is incorporated into earlier investor bids has a stronger influence on later investor demand for shares of follow-on fixed-price offers than does the private information that is incorporated into investors' bids. Finally, we find that herding is more likely to occur in fixed-price offerings than in auctions. We interpret the evidence as suggesting that investor characteristics and IPO selling methods are related to herding in IPO markets.

References

Aggarwal, R. "Allocation of Initial Public Offerings and Flipping Activity," *Journal of Financial Economics* 68 (2003), 111-135.

Aggarwal, R., N. R. Prabhala, and M. Puri. "Institutional Allocation in Initial Public Offerings: Empirical Evidence," *Journal of Finance* 57 (2002), 1421-1442.

Amihud, Y., S. Hauser, and A. Kirsh. "Allocations, Adverse Selection and Cascades in IPOs: Evidence from Israel," *Journal of Financial Economics* 68 (2003), 137-158.

Benveniste, L. M., and W. Y. Busaba. "Bookbuilding vs. Fixed Price: An Analysis of Competing Strategies for Marketing IPOs," *Journal of Financial and Quantitative Analysis* 32 (1997), 383-403.

Benveniste, L. M., W. Y. Busaba, and W. Wilhelm. "Information Externalities and the Role of Underwriters in Primary Equity Markets," *Journal of Financial Intermediation* 11 (2002), 61-80.

Benveniste, L. M., and W. J. Wilhelm. "A Comparative Analysis of IPO Proceeds under Alternative Regulatory Environments," *Journal of Financial Economics* 28 (1990), 173-207.

Biais, B., P. Bossaerts, and J. C. Rochet. "An Optimal IPO Mechanism," *Review of Economic Studies* 69 (2002), 117-146.

Biais, B., and A. M. Faugeron-Crouzet. "IPO Auctions: English, Dutch, … French, and Internet," *Journal of Financial Intermediation* 11 (2002), 9-36.

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

Chemmanur, T., and H. M. Liu. "How Should a Firm Go Public? A Dynamic Model of the Choice Between Fixed-Price Offerings and Auctions in IPOs and Privatizations," Working Paper, Boston College. (2002) .

Chowdhry, B., and A. Sherman. "International Differences in Over-subscription and Underpricing of IPOs," *Journal of Corporate Finance* 2 (1996), 359-381.

Cornelli, F., and D. Goldreich. "Bookbuilding: How Informative is the Order Book?" *Journal of Finance* 58 (2003), 1415-1444.

Daniel, K. "Discussion of 'Why Don't Issuers Get Upset About Leaving Money on the Table in IPOs?' " *Review of Financial Studies* 15 (2002), 445-454.

Daniel, K., D. Hirshleifer, and A. Subrahmanyam. "Investor Psychology and Security Market Under- and Over-reactions," *Journal of Finance* 53 (1998), 1839-1886.

Derrien, F., and K. L. Womack. “Auction vs. Bookbuilding and the Control of Underpricing in Hot IPO Markets,” *Review of Financial Studies* 16 (2003), 31-61.

Draho, J. “The Coordinating Role of Public Information in Hot Market IPOs,” Working Paper, Yale University. (2001)

Draho, J. “The Timing of Initial Public Offerings: A Real Option Approach,” Working Paper, Yale University. (2000)

Kahneman, D., and A. Tversky. “Prospect Theory: An Analysis of Decision Under Risk,” *Econometrica* 47 (1979), 263-291.

Lee, C., A. Shleifer, and R. Thaler. “Investor Sentiment and the Closed-end Fund Puzzle,” *Journal of Finance* 46 (1991), 29-48.

Lee, P. J., S. L. Taylor, and T. S. Walter. “IPO Underpricing Explanations: Implications from Investor Application and Allocation Schedules,” *Journal of Financial and Quantitative Analysis* 34 (1999), 425-444.

Lerner, J. “Venture Capitalists and the Decision to Go Public,” *Journal of Financial Economics* 35 (1994), 293-316.

Ljungqvist, A., V. Nanda, and R. Singh. “Hot Markets, Investor Sentiment, and IPO Pricing,” Working Paper, New York University. (2001).

Loughran, T., and J. Ritter. “Why Don’t Issuers Get Upset about Leaving Money on the Table in IPOs?” *Review of Financial Studies* 15 (2002), 413-443.

Lowry, M., and G. W. Schwert. “Is the IPO Pricing Process Efficient?” *Journal of Financial Economics* 71 (2004), 3-26.

Ritter, J., and I. Welch. “A Review of IPO Activity, Pricing, and Allocations,” *Journal of Finance* 57 (2002), 1795-1828.

Schultz, P. “Pseudo Market Timing and the Long-Run Underperformance of IPOs”, Journal of Finance 58 (2003), 483-518.

Sherman, A. “Global Trends in IPO Methods: Book Building versus Auctions,” Working Paper, University of Notre Dame. (2003)

Subrahmanyam, A., and S. Titman. “The Going Public Decision and the Development of Financial Markets,” *Journal of Finance* 54 (1999), 1045-1082.

Thaler, R., and E. Johnson. “Gambling with House Money and Trying to Break Even: The Effect of Prior Outcomes on Risky Choice,” *Management Science* 36 (1990), 643-660.

Welch, I. “Sequential Sales, Learning, and Cascades,” *Journal of Finance* 47 (1992), 695-732.

White, H. “A Heteroskedaticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedaticity,” *Econometrica* 48 (1980), 817-838.

Appendix: Pricing rule for follow-on fixed-price offerings

Suppose an issuing firm puts 10,000 IPO shares at the auction with an initial price range of $20 to $30. The issuer will set the offer price for the follow-on fixed-price offering following one of three procedures.

Case 1: Oversubscription and auction clearing price above the initial price range

The Taiwan Securities Dealers Association collects investors' bids and compiles a demand schedule:

Bidder	Shares bid	Bid price
A	4,000	$40
B	6,000	35
C	6,000	31
D	8,000	28
E	8,000	24
F	9,000	22

The Association will fill orders submitted from bidders A and B, who together absorb the 10,000 auctioned shares. As the clearing price, $35 in this case, is above the initial price range, the issuer will take the maximum price of the initial price range, $30 in this case, as the offer price in the follow-on fixed-price offer.

Case 2: Oversubscription and auction clearing price within the initial price range

The Taiwan Securities Dealers Association collects investors' bids and compiles a demand schedule:

Bidder	Shares bid	Bid price
A	2,000	$34
B	2,000	31
C	3,000	28
D	3,000	26
E	4,000	22
F	5,000	20

The Association will fill orders submitted from bidders A, B, C, and D, who together absorb the 10,000 auctioned shares. As the clearing price, $26 in this case, is within the initial price range, the issuer will set the offer price of the follow-on fixed-price offer at the quantity-weighted price calculated from the winning bids with bidding prices within the initial price range, i.e., bids from C and D. In this case, the offer price is set at $27 ($28 × 3,000 shares/6,000 shares + $26 × 3,000 shares/6,000 shares).

Case 3: Undersubscription

The Taiwan Securities Dealers Association collects investors' bids and compiles a demand schedule:

Bidder	Shares bid	Bid price
A	1,000	$26
B	1,000	24
C	2,000	22
D	2,000	20
E	--	--
F	--	--

Since the total number of shares wanted is less than the number of auctioned shares, the Association will fill all investors' orders, and the issuer will set the auction base price, $20 in this case, as the offer price of the follow-on fixed-price offer.

Figure 1: Timing of hybrid selling procedure

Step 1: The minimum price and initial price range are chosen
Step 2: Investors submit price/quantity bids
Step 3: Discriminatory allocation to investors
Step 4: Set the open offer price within the initial price range
Step 5: Investors submit subscriptions to open offer
Step 6: Open offer allocation by lottery
Step 7: Shares traded on Exchange

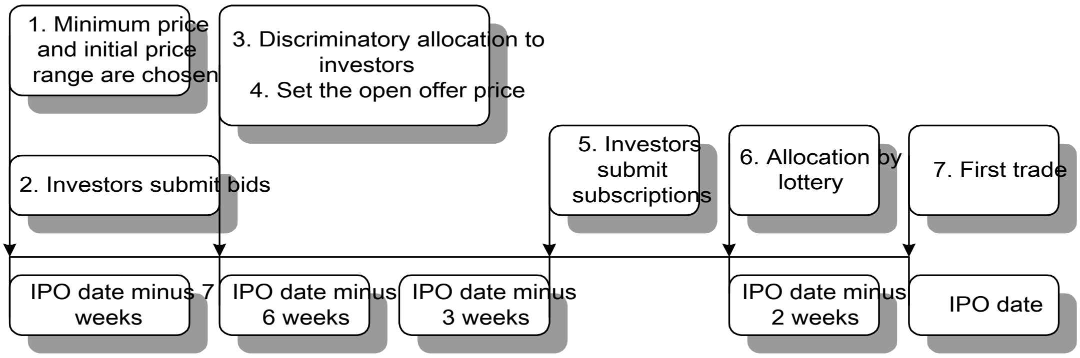
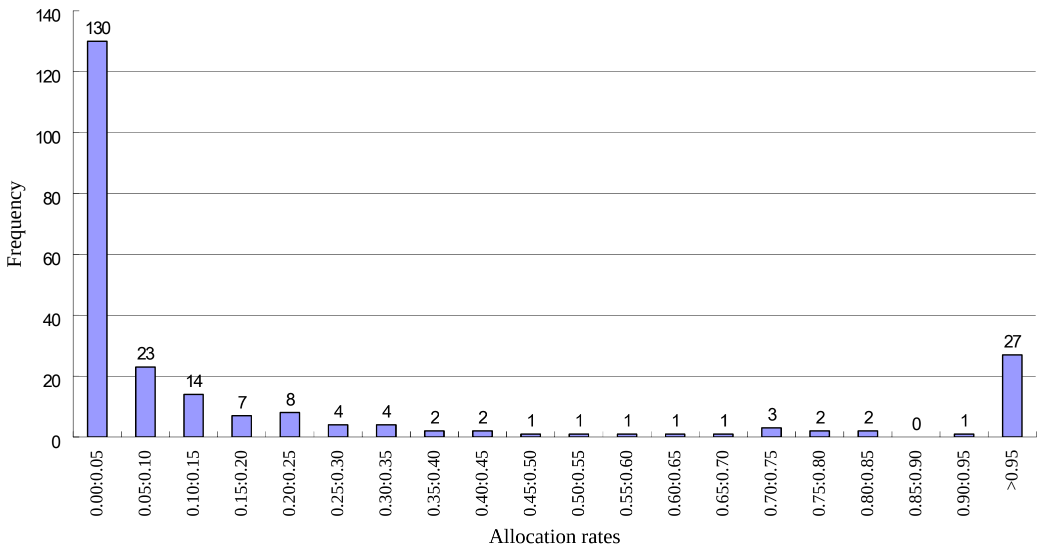
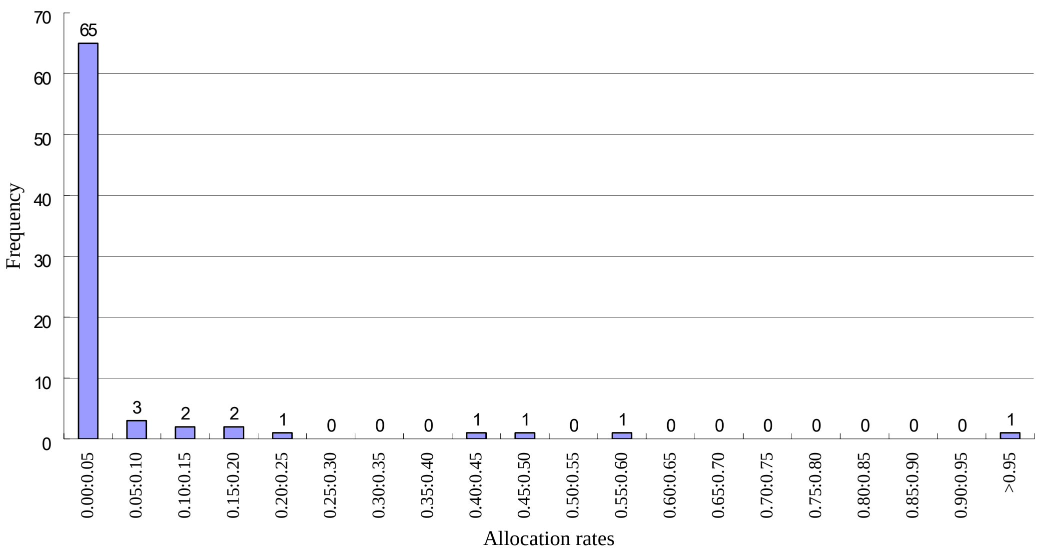


Figure 2: Distribution of allocation rates to investors in IPOs: Pure fixed-price offerings vs. follow-on fixed-price offerings

A. Pure fixed-price

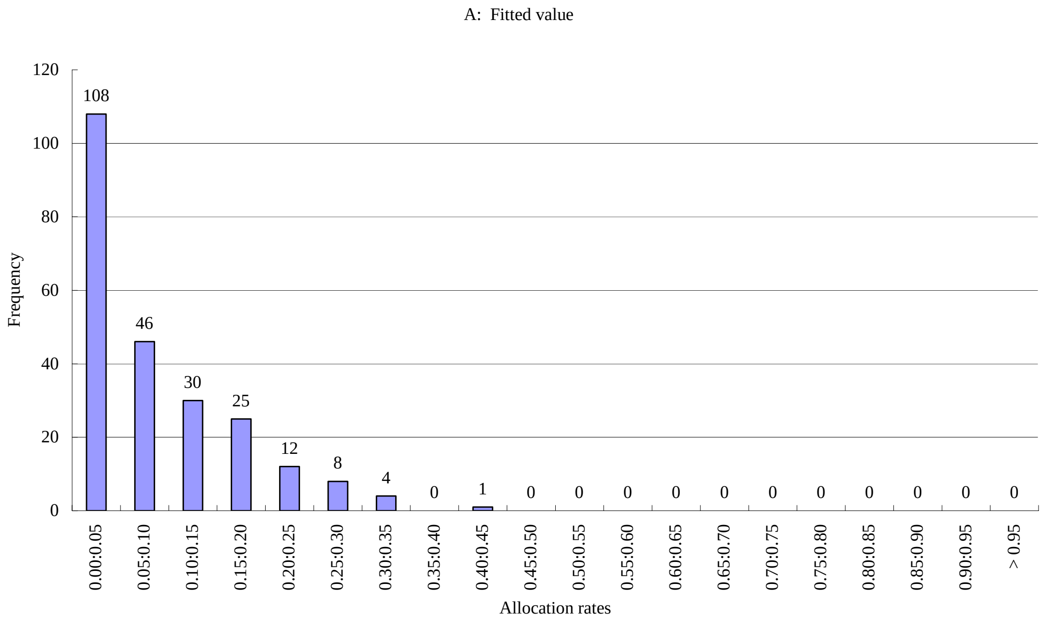


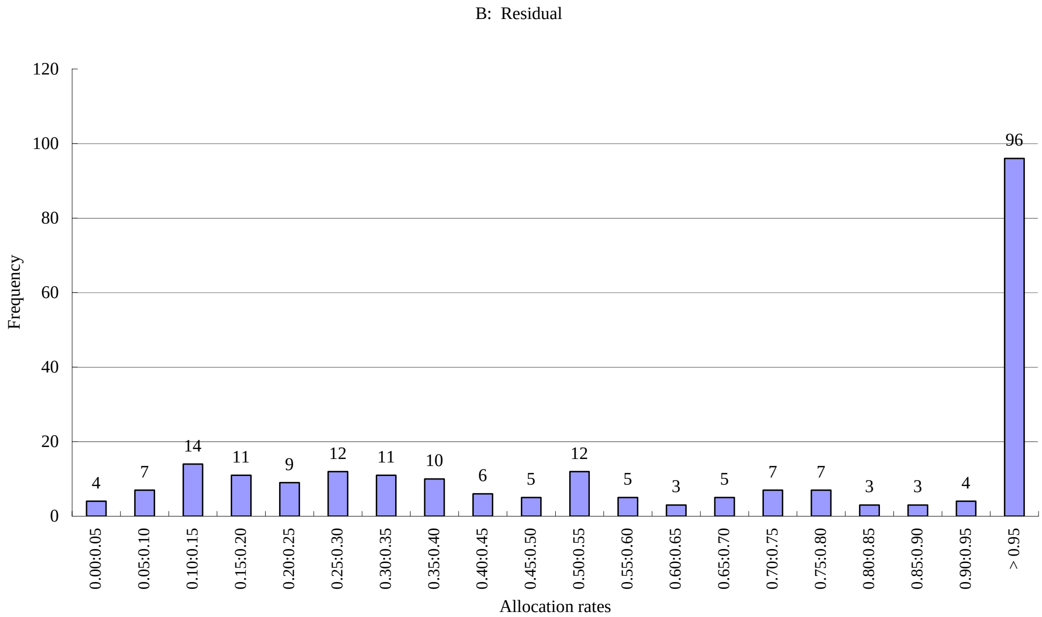
B. Hybrid fixed-price



The first histogram shows the allocation calculated as the ratio of issued shares to the total demand for shares at the pure fixed-price offerings. The average is 0.4656. The second histogram shows the allocation at the hybrid fixed-price offerings. The average is 0.0758.

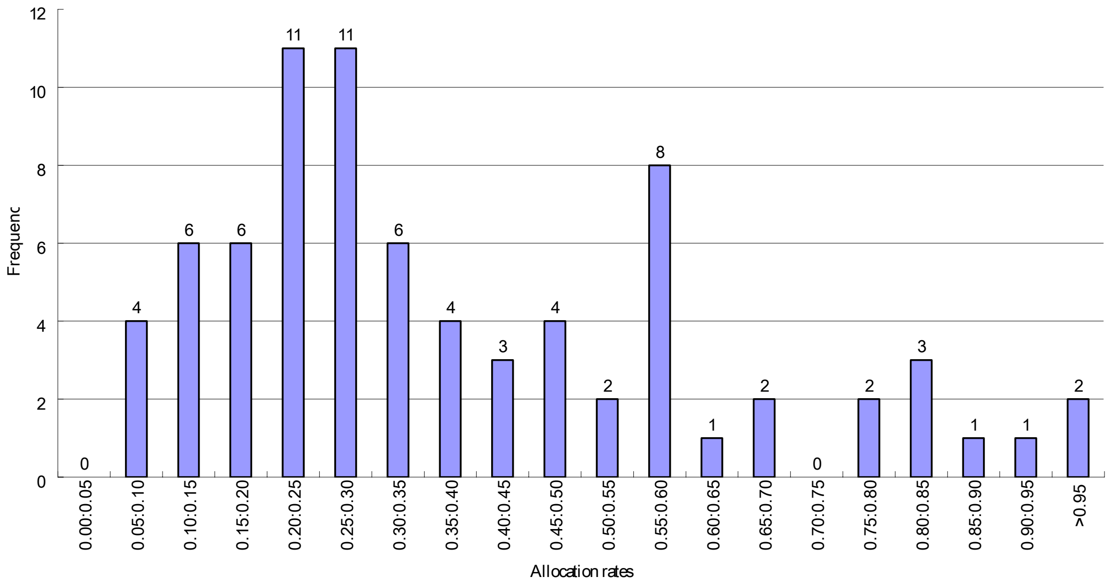
Figure 3: Distribution of fitted and of the residual allocation rates for 234 pure fixed-price offerings





The first histogram shows the distribution of the fitted allocation rates for 234 pure fixed-price IPOs and the second shows the distribution of the residual allocation rates. The fitted values and residuals are from Reg5 of Table 4.

Figure 4: Distribution of allocation rates for 77 IPO auctions



The histogram shows the allocation calculated as the ratio of issued shares to total demand for shares of 77 IPO auctions. The average allocation rate is 0.4056.

Table 1

Number of IPOs categorized by year, offer type, exchange, and industry

IPOs with closed-end funds and Taiwan Depository Receipts have been excluded. We collect the original sample from the database of the Taiwan Securities Dealers Association. 311 sample companies went public during the sample period from January 1996 through June 2000. TSE represents the Taiwan Stock Exchange and OTC represents the over-the-counter market.

Year	Total Number of IPOs	Pure Fixed-price Offers					Hybrid Offers				
		Exchange		Industry		Total	Exchange		Industry		Total
		TSE	OTC	High-tech	Traditional		TSE	OTC	High-tech	Traditional	
1996	65	31	28	24	35	59	5	1	1	5	6
1997	35	4	8	1	11	12	16	7	7	16	23
1998	53	9	21	9	21	30	13	10	15	8	23
1999	111	11	81	41	51	92	8	11	12	7	19
2000	47	6	35	22	19	41	2	4	6	0	6
Total	311	61	173	97	137	234	44	33	41	36	77

Table 2
Summary statistics for 311 IPOs by year

The allocation rate is the total supply of shares divided by total demand of shares. Because of the 7 percent daily limit imposed on the price movements of securities traded in Taiwanese stock markets, security prices may continue to hit the limit many days following the listing day. Therefore, the initial returns are the cumulative returns until the day on which the limit is not hit. Sales are based on financial statements of the year preceding the IPO. Age is the number of years from the year of inception of the firm to the IPO year. During the sample period, the exchange rate ranges from about 27 to 35 NT$/US$.

Panel A: Pure Fixed-price Offers

Year	Number of IPOs by Allocation Rate			Total Number of IPOs	Initial Return Mean [Median] (%)	IPO Proceeds Mean [Median] (NT$ millions)	Fraction of Equity Sold Mean [Median] (%)	Issue Price Mean [Median] (NT$)	Sales Mean [Median] (NT$ billions)	Age Mean [Median] (years)
	Greater than 0.95	Less than 0.05	Between 0.95 and 0.05							
1996	8	29	22	59	21.60 [14.28]	640.20 [260.93]	16.24 [10.20]	29.55 [25.00]	4.96 [1.90]	16.81 [13.50]
1997	0	12	0	12	55.14 [69.34]	532.36 [136.97]	13.32 [5.81]	28.88 [25.00]	6.15 [1.60]	23.95 [19.08]
1998	2	12	16	30	3.91 [-1.96]	879.87 [267.54]	25.18 [7.50]	34.32 [32.25]	4.38 [1.86]	18.19 [13.45]
1999	17	44	31	92	14.98 [5.35]	224.92 [136.57]	7.09 [4.15]	35.37 [29.00]	2.13 [1.28]	18.66 [16.37]
2000	0	34	7	41	39.78 [31.37]	248.14 [171.30]	5.44 [3.79]	46.34 [36.00]	2.52 [1.01]	16.75 [16.67]
Total	27	131	76	234	21.64 [12.30]	433.43 [165.26]	11.75 [5.00]	35.36 [28.50]	3.41 [1.38]	18.07 [15.23]

Table 2 (continued)

Panel B: Hybrid Offers

Year	Number of IPOs by Allocation Rate (followed-on fixed-price offers)			Total Number of IPOs	Initial Return Mean [Median] (%)	IPO Proceeds Mean [Median] (NT$ millions)	Fraction of Equity Sold Mean [Median] (%)	Issue Price Mean [Median] (NT$)	Sales Mean [Median] (NT$ billions)	Age Mean [Median] (years)
	Greater than 0.95	Less than 0.05	Between 0.95 and 0.05							
1996	0	4	2	6	36.23 [29.89]	1,482.87 [871.57]	26.88 [19.68]	46.46 [44.25]	4.98 [1.70]	24.57 [23.34]
1997	0	22	1	23	22.71 [20.07]	1,258.13 [783.36]	19.97 [15.31]	54.94 [51.00]	6.58 [2.13]	19.53 [18.52]
1998	0	22	1	23	12.77 [12.52]	921.14 [573.70]	13.23 [11.10]	68.13 [54.00]	2.82 [1.65]	14.15 [12.41]
1999	1	11	7	19	13.40 [6.74]	1,051.44 [448.15]	12.25 [7.47]	73.79 [40.01]	5.16 [1.73]	16.00 [15.88]
2000	0	6	0	6	76.88 [72.33]	607.77 [621.70]	8.40 [7.78]	75.27 [70.80]	2.69 [2.58]	11.32 [6.37]
Total	1	65	11	77	22.72 [13.41]	1,073.30 [680.40]	15.69 [11.68]	64.46 [51.00]	4.68 [1.81]	16.80 [14.70]

Table 3
Descriptive statistics for public information variables on 311 IPOs

Ln_sale, a variable proxy for firm size, is the natural logarithm of the yearly sales preceding the IPO year. *Hi_tech* is a dummy variable equal to 1 if the firm is a high technology firm. *Market index return variable*, which captures market conditions, is constructed as a three-month weighted average of the buy-and-hold returns of the Taiwan Stock Exchange index with weights of 3 for the most recent month, 2 for the next month, and 1 for the third month before the subscription beginning date. *Oversubscription variable*, which measures the demand of other contemporaneous IPOs, is constructed as a three-month weighted average of the monthly average oversubscription of other contemporaneous IPOs for each of the three months before the subscription beginning date. *Initial return variable*, which measures the pricing of other contemporaneous IPOs, is constructed as a three-month weighted average of the arithmetic average initial return of other contemporaneous IPOs for each of the three months before the subscription beginning date.

		Pure Fixed-Price Offerings	Follow-on Fixed-Price Offerings	Mean Differences (t-statistic)
Ln_sale	Mean	14.2585	14.6580	-0.3995
	Std. dev.	1.0797	1.0004	(-2.96)*
	Median	14.1363	14.4068	
Hi_tech	Total number	97	41	
	Percent (%)	41.45	53.25	11.79
				(-1.79)
Market index *return variable (%)*	Mean	2.6393	0.4583	2.1811
	Std. dev.	5.8674	6.6674	(2.55)*
	Median	1.9400	0.2117	
Oversubscription *variable*	Mean	58.5732	81.1222	-22.5491
	Std. dev.	45.2803	69.6433	(-2.65)*
	Median	37.8084	62.2305	
Initial return variable (%)	Mean	18.3041	19.0311	-0.7270
	Std. dev.	16.9012	18.0738	(-0.31)
	Median	15.0223	16.1059	

* Significant at the 5% level.

Table 4
Oversubscription for 234 pure fixed-price offerings

This table presents regression coefficients (and White's (1980) heteroskedasticity-adjusted t-statistics in parentheses) for various model specifications on 234 pure fixed-price offerings. The dependent variable in these regressions is the natural logarithm of the open offer oversubscription. Mkt_rtn is the market index return, which is constructed as a three-month weighted average of the buy-and-hold returns of the Taiwan Stock Exchange index with weights of 3 for the most recent month, 2 for the next month, and 1 for the third month before the subscription beginning date. Ln_os is the natural logarithm of the oversubscription variable, which is constructed as a three-month weighted average of the monthly average oversubscription of other contemporaneous IPOs for each of the three months before the subscription beginning date. Ir_cipo is the initial return variable, constructed as a three-month weighted average of the arithmetic average initial return of other contemporaneous IPOs for each of the three months before the subscription beginning date. Hi_tech is a dummy variable equal to 1 if the firm is a high technology firm. Ln_sale, a variable proxy for firm size, is the natural logarithm of the yearly sales preceding the IPO year.

Dependent Variable	*Ln(oversubscription)*					
	Reg1	Reg2	Reg3	Reg4	Reg5	Reg6
Intercept	2.4653 (18.04)*	-0.9805 (-1.77)	0.0978 (0.18)	1.9705 (10.78)*	0.0895 (0.13)	2.5806 (1.84)
Mkt_rtn	0.1555 (9.11)*		0.1135 (6.08)*		0.1138 (5.26)*	0.0932 (4.66)*
Ln_os		1.0273 (7.20)*	0.6603 (4.25)*		0.6636 (3.06)*	0.3617 (1.90)
Ir_cipo				0.0495 (7.32)*	-0.0003 (-0.02)	0.0148 (1.65)
Hi_tech						1.8673 (10.16)*
Ln_sale						-0.1650 (-1.80)
Adjusted R-squared	20.32%	17.38%	25.84%	16.98%	25.52%	47.29%

* Significant at the 5% level.

Table 5
Descriptive statistics for fitted allocation rates and residual allocation rates

The fitted and residual oversubscriptions in Table 4 are transformed into fitted and the residual allocation rates in this table. The fitted values in Reg1 through Reg6 are the fitted allocation rates equivalent to 1/oversubscription, where the oversubscription is the antilogarithm of fitted *ln(oversubscription)* in Reg1 to Reg6 of Table 4, and the residuals in Reg1 to Reg6 are the residual allocation rates equivalent to 1/(residual oversubscription), where the residual oversubscription is the antilogarithm of residuals in Reg1 to Reg6 of Table 4.

Item		Mean	Std Dev	Median	Max.	Min.
Reg1	Fitted value	0.0800	0.0661	0.0629	0.4153	0.0057
	Residual	6.6456	23.2168	0.7644	231.3768	0.0125
Reg2	Fitted value	0.0786	0.0623	0.0639	0.2486	0.0116
	Residual	7.9651	28.9667	0.5995	299.3985	0.0582
Reg3	Fitted value	0.0879	0.0783	0.0588	0.4074	0.0054
	Residual	7.2056	29.0235	0.7255	306.6873	0.0394
Reg4	Fitted value	0.0736	0.0448	0.0663	0.1832	0.0066
	Residual	7.1399	24.0855	0.7373	268.8248	0.0232
Reg5	Fitted value	0.0880	0.0784	0.0590	0.4080	0.0054
	Residual	7.2080	29.0366	0.7265	306.6567	0.0394
Reg6	Fitted value	0.1232	0.1411	0.0640	0.7103	0.0019
	Residual	3.7304	12.3069	0.8452	135.9143	0.0166

Table 6
Regression analyses on initial returns of 96 undersubscription offerings

96 offerings have a residual allocation rate of higher than 95%. These residual allocation rates are from Reg5 of Table 4. The dependent variable is the initial return. *Mkt_rtn* is the *market index return*, which is constructed as a three-month weighted average of the buy-and-hold returns of the Taiwan Stock Exchange index with weights of 3 for the most recent month, 2 for the next month, and 1 for the third month before the IPO date. *Ir_cipo* is the *initial return variable*, constructed as a three-month weighted average of the arithmetic average initial return of other contemporaneous IPOs for each of the three months before the IPO date. *Hi_tech* is a dummy variable equal to 1 if the firm is a high technology firm. *Ln_sale*, a variable proxy for firm size, is the natural logarithm of the yearly sales preceding the IPO year. *NC* is a dummy variable equal to 1 if firms eventually experience a negative cascade with an allocation rate of higher than 95%. *NNC* is a dummy variable equal to 1 if firms do not experience a negative cascade. In parentheses are White's (1980) heteroskedasticity-adjusted t-statistics.

Dependent Variable	Initial Return		
	Reg1	Reg2	Reg3
Intercept	10.1097 (3.23)*	9.9085 (0.50)	9.2408 (0.46)
Mkt_rtn		2.1826 (4.66)*	
Ir_cipo		0.0273 (0.30)	
Hi_tech		14.5718 (2.11)*	14.0749 (2.25)*
Ln_sale		-0.7601 (-0.56)	-0.8358 (-0.60)
NC (negative cascades)	-18.3523 (-4.27)*	-6.7677 (-1.48)	-1.8597 (-0.39)
(Mkt_rtn)(NC)			0.2930 (0.44)
(Ir_cipo)(NC)			-0.4055 (-0.70)
(Mkt_rtn)(NNC)			2.6523 (5.39)*
(Ir_cipo)(NNC)			0.0375 (0.42)
Adjusted R-squared	10.03%	43.26%	50.00%

* Significant at the 5% level.

Table 7
Regression analyses on underpricing of positive and negative cascades

This table reports the regression analyses on the underpricing of 130 positive cascades and 27 negative cascades in pure fixed-price offers. These cascades are from Panel A of Figure 2. The dependent variable is the initial return. *Mkt_rtn* is the *market index return*, which is constructed as a three-month weighted average of the buy-and-hold returns of the Taiwan Stock Exchange index with weights of 3 for the most recent month, 2 for the next month, and 1 for the third month before the IPO date. *Ir_cipo* is the *initial return variable*, constructed as a three-month weighted average of the arithmetic average initial return of other contemporaneous IPOs for each of the three months before the IPO date. *Hi_tech* is a dummy variable equal to 1 if the firm is a high technology firm. *Ln_sale*, a variable proxy for the firm size, is the natural logarithm of the yearly sales preceding the IPO year. *NC* is a dummy variable equal to 1 if firms eventually experience a negative cascade with an allocation rate of higher than 95%. *PC* is a dummy variable equal to 1 if firms experience a positive cascade with an allocation rate of lower 5%. In parentheses are White's (1980) heteroskedasticity-adjusted t-statistics.

	Reg1	Reg2	Reg3
Intercept	38.0233 (13.99)*	40.4479 (1.14)	39.4228 (1.09)
Mkt_rtn		1.9533 (4.83)*	
Ir_cipo		0.1416 (0.93)	
Hi_tech		16.1903 (3.34)*	16.6777 (3.44)*
Ln_sale		-1.8512 (-0.75)	-1.9460 (-0.78)
NC (negative cascades)	-46.2659 (-7.06)*	-22.6775 (-4.01)*	-16.4401 (-2.68)*
(Mkt_rtn)(NC)			0.1903 (0.28)
(Ir_cipo)(NC)			-0.3669 (-0.64)
(Mkt_rtn)(PC)			2.1712 (5.10)*
(Ir_cipo)(PC)			0.1803 (1.16)
Adjusted R-squared	23.85%	40.10%	41.50%

* Significant at the 5% level.

Table 8
Summary statistics for publicized information variables

The sample is 77 hybrid IPOs from January 1996 through June 2000 offered on the Taiwan Stock Exchange (44) and over-the-counter (33). NQWP (winning bids) is the normalized quantity-weighted bidding price for winning bids, which is equal to (Pw – Pmin)/(Pmax – Pmin), where Pw is the quantity-weighted bidding price for winning bids, and Pmax and Pmin are, respectively, the maximum and the minimum of the initial price range announced by the underwriter. Oversubscription in auctions is given by total demand/supply of shares, where demand is measured at the lowest bidding price.

Item	Mean	Std Dev	Maximum	Minimum	Median
NQWP (winning bids)	1.56	1.20	7.87	0.11	1.28
Oversubscription (auction)	3.94	2.98	17.20	0.39	3.30
Number of bids (auction)	987	1,120	5,406	39	645

Table 9
Public information and investor bids for 77 IPO auctions

This table reports coefficients (and White's (1980) heteroskedasticity-adjusted t-statistics in parentheses) for regressions related to the effect of market index returns, initial returns, industry and firms' sales on investors' bidding prices, the over-subscription, and the number of bids. *NQWP* (winning bids) is the quantity-weighted bidding price for winning bids normalized to the price range. *Ln_os* is the logarithm of total demand/supply of shares, where demand is measured at the lowest bidding price. *Ln_nob* is the natural logarithm of the number of bids. *Mkt_rtn* is the market index return prior to the auction period. *Ir_cipo* is the initial return of other contemporaneous IPOs prior to the auction period. *Hi_tech* is a dummy set to one for issuers in a high-tech industry. *Ln_sale* is the logarithm of annual sales.

Dependent Variable	*NQWP* (winning bids)	*Ln_os*	*Ln_nob*
Independent Variable	Reg1	Reg2	Reg3
Intercept	3.67 (2.55)*	-0.24 (-0.22)	0.62 (0.41)
Mkt_rtn	0.02 (0.63)	-0.01 (-0.98)	0.06 (2.64)*
Ir_cipo	0.03 (3.78)*	0.02 (5.22)*	0.02 (2.38)*
Hi_tech	0.78 (3.33)*	0.14 (0.95)	0.31 (1.48)
Ln_sale	-0.22 (-2.16)*	0.06 (0.80)	0.35 (3.36)*
Adjusted R-squared	31.21%	24.54%	35.92%
N	77	77	77

* Significant at the 5% level.

Table 10
Regression analyses of oversubscription to publicized information: 77 follow-on fixed-price offerings

The dependent variable is the natural logarithm of oversubscription in follow-on fixed-price offerings. *Ln_os* is the natural logarithm of the oversubscription in auctions, which is given by total demand/supply of shares, where demand is measured at the lowest bidding price. *NQWP* is the normalized quantity-weighted bidding price for winning bids, which is equal to (Pw – Pmin)/(Pmax – Pmin), where Pw is the quantity-weighted bidding price for winning bids and Pmax and Pmin are, respectively, the maximum and the minimum of the initial price range announced by the underwriter. *Ln_nob* is the natural logarithm of the number of bids in auctions. Fitted values and residuals are derived from regressions of Table 9. In parentheses are White's (1980) heteroskedasticity-adjusted t-statistics.

Dependent Variable	*Ln[Oversubscription (follow-on fixed-price offerings)]*				
	Reg1	Reg2	Reg3	Reg4	Reg5
Intercept	0.1847 (0.25)	0.1582 (0.10)	0.9500 (1.59)	4.0289 (30.09)*	4.0289 (29.52)*
Ln_os	0.6202 (3.02)*				
Fitted value		2.3168 (2.00)*	2.7682 (3.11)*		
Residual				0.5027 (1.38)	0.9397 (3.86)*
NQWP	0.3317 (2.70)*				
Fitted value		0.0139 (0.04)	-0.0499 (-0.14)		
Residual				0.1580 (0.86)	0.1182 (0.66)
Ln_nob	0.4125 (3.41)*				
Fitted value		0.1901 (0.55)			
Residual				0.4035 (1.65)	
Adjusted R-squared	59.38%	40.74%	41.11%	19.28%	17.26%

* Significant at the 5% level.