IPO 競價拍賣中投資人標單的資訊內涵：以臺灣為例

Information Content of Investors' Bids in IPO Auctions: Evidence from Taiwan

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摘　要

本文探討臺灣的 IPO 競價拍賣中投資人標單的資訊內涵。結果發現，競價拍賣之標單會納入可利用之公開訊息，顯示投資人在下競價拍賣標單之前會參考市場的公開資訊。此外，投資人的標單具有預測上市後報酬的能力，競價拍賣的標單平均價格與上市後之初期報酬具有顯著地正向關係。而機構投資人在競價拍賣的分配比率亦具有預測上市後報酬的能力，顯示機構投資人對於 IPO 發行公司的真實價值具有較佳的資訊。最後，本文發現，市場公開資訊都已經反映到投資人的標單內涵中，所剩餘的公開資訊已經沒有預測未來上市後報酬的能力。

Abstract

This paper examines the information content of investors' bids in IPO auctions. We discover that investors' bids contain public information known before the auction period, suggesting that investors, on average, condition their bids on public information known before the auction period. We also find that investors' bids contain information relevant to predicting aftermarket returns. The average investors' bidding price can predict aftermarket returns. Institutional allocation also predicts aftermarket returns, suggesting that institutional investors might have better information concerning the value of IPO shares. Finally, we find that our public information variables are relevant to predicting aftermarket returns only insofar as the information has been incorporated in investors' bids.

關鍵字：初次公開上市、公開資訊、競價拍賣、上市的訂價區間
Key words: IPOs; public information; auctions; initial price ranges

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I. Introduction

One of the many roles that underwriters perform in IPOs is to gather pricing information from investors. Bookbuilding and auctions are two major selling mechanisms aimed at retrieving relevant pricing information from investors. Benveniste and Spindt (1989) and Spatt and Srivastava (1991) argue that the function of bookbuilding is to gather information about the value of the shares that are being issued. On the other hand, Benveniste and Wilhelm (1990) and Biais and Faugeron-Crouzet (2002) argue that an auction is essentially equivalent to the bookbuilding method with regard to its ability to convey information to investors.[1]

This article examines the capability of Taiwanese IPO auctions to convey information to investors. We use a dataset of 77 Taiwanese discriminatory (pay as you bid) auctions to examine a two-fold question: first, the relationship between public information known before the auction period and investors' bidding behaviors during an auction, and second, the relationship between the information content of IPO auctions and aftermarket returns. In other words, on the first level, we examine the extent to which investors have incorporated public information known before the auction period in their bids; then, on the second level, we investigate whether investors' bids in an auction contain information relevant to predicting aftermarket returns.

Some recent papers have examined the role of public information in IPOs under a bookbuilding setting. For example, Cornelli and Goldreich (2003) find that investors submit their limit prices according to certain public information, such as the industry factor and the size of a firm. In addition, Lowry and Schwert (2001), Loughran and Ritter (2002), Derrien and Womack (2003), and Bradley and Jordan (2002) all show that public information, such as market index returns and initial returns of other contemporaneous IPOs prior to the bookbuilding period, affects aftermarket returns.

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[1] In general, underwriters in a bookbuilding procedure will not release the details of pricing information collected from investors. Investors can only observe the issue price set by underwriters. Under an auction procedure, underwriters usually will release the collected information upon the completion of the auction.

For Taiwanese discriminatory auctions, we, first, find that the initial return of other contemporaneous IPOs has a very strong influence on investors' biddings. When the initial return of other contemporaneous IPOs is relatively high, investors will submit higher bidding prices and large bids.

We also find that the industry factor affects investors' bidding prices. Investors submit higher bidding prices for shares of high-tech firms. The size of a firm, as captured by sales, affects investors' biddings as well. We find that institutional investors bid aggressively for shares of large firms, while retail investors bid aggressively for shares of small firms.

Second, we find that both the average investors' bidding price and the institutional allocation proportion affect aftermarket returns; in other words, investors' bids in an auction contain information that can be employed to predict aftermarket returns.

Our results have implications to investors who will subscribe to shares of follow-on fixed-price offerings in Taiwanese sequential hybrids; for, upon the completion of an auction, underwriters will announce the demand schedule of winning bids, from which investors can derive the average investors' bidding price and the institutional allocation proportion, on which they can condition subscription to shares of follow-on fixed-price offerings.

Previously, we find that public information affects the average investors' bidding price and the institutional allocation proportion, which in turn affect aftermarket returns. Therefore, it is quite likely that our public information variables, including industry factor, firm size, market index returns, and initial returns of other contemporaneous IPOs, can predict aftermarket returns. We find that aftermarket returns are indeed significantly related to the fitted values of regressing investors' bidding prices on our public information variables, suggesting that underwriters have not fully incorporated public information known before the auction period in the initial price range they set.

We also find that the residual values of regressing institutional allocation proportions on our public information variables can predict aftermarket returns, suggesting that institutional allocation might contain private information about the value of IPO shares. This result is complementary to and consistent with Aggarwal, Prabhala, and Puri (2002), who by investigating the bookbuilding method also find that institutional allocation contains private information about IPO initial returns.

We, however, have a more affirmative result than Aggarwal et al. (2002) on two aspects. First, we control the effect of several important public information variables, such as market index returns prior to auctions, initial returns of other contemporaneous IPOs, and firms' characteristics, while Aggarwal et al. (2002) only control the effect of firms' characteristics. Second, underwriters do not have any latitude on how IPO shares are allocated in our IPO auctions; hence, we may safely conclude that the positive relation between institutional allocation and aftermarket returns is not attributed to bookbuilding theories of IPO underpricing, which posit that underwriters give institutional investors more shares in IPOs with strong pre-market demand.

Some papers in the auction literature have examined the information contained in investors' bids and studied its relation to aftermarket returns. For example, Kandel, Sarig, and Wohl (1999) analyze the demand schedule of 27 Israeli uniform-price auctions. They find that the demand elasticity is positively related to aftermarket returns. Liu, Wei, and Liaw (2001) document a similar result for 52 Taiwanese discriminatory auctions. However, both studies have not examined the role public information plays in IPO auctions.

The contributions of this paper are two-fold. First, we document that bidders, on average, condition subscription to auctioned shares on public information, and the public information incorporated in investors' bids can predict aftermarket returns. This indicates that underwriters have not fully incorporated public information known before the auction period when they set the initial price range. Second, we show that aftermarket returns can be predicted by the publicized information, such as the average investors' bidding price and institutional allocation, on which investors can condition their subscription to shares of follow-on fixed-price offerings in Taiwanese sequential hybrids. In addition, institutional allocation can predict aftermarket returns, suggesting that institutional investors might have better information than retail investors.

The rest of this paper proceeds as follows. Section II describes the auction selling procedure in Taiwan. Data and summary statistics are described in Section III. Section IV describes the information derived from investors' bids. Section V analyzes the relationship between public information and investors' bids. Section VI investigates the relationship between the information content of IPO auctions and aftermarket returns, and Section VII concludes this paper with a summary.

II. The Auction Selling Procedure 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). In the event of oversubscription occurs, underwriters adopt a lottery to allocate shares.

The Taiwanese hybrid selling procedure is a market-driven mechanism, giving the decision making to investors. Taiwan adopted this formal auction from Japan, making the Taiwanese system quite similar to the Japanese one.[2] In the sequential hybrid procedure, an issuer will put 50% of IPO shares in an auction, and follow this with a fixed-price 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 multiple 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 Securities Dealer Association computes a cumulative demand curve. The Association will then fill orders, starting with the higher bidding prices first until all auctioned shares are distributed, and will randomly fill orders with the same bidding price. Each winning bidder pays what it bids. The Association will then announce to the public 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 offerings is as follows: First, if

[2] The Japan Securities Dealers Association under the guidance of the Ministry of Finance introduced the formal auction, and this regulatory change made auctions compulsory for IPOs between 1989 and 1997. For a detailed description of this structural change, see Pettway and Kaneko (1996).

[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.

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 maximum price, 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.

The underwriter will conduct the follow-on fixed-price offer about three calendar weeks after the announcement of the auction results; and the selling procedure is the same as in the pure fixed-price method. The fixed-price offer will last one calendar week; and the IPO date is two calendar weeks from the closing date of the fixed-price offer.

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

Insert Figure 1 about here

III. Data and Summary Statistics

We analyze 77 IPO auctions during the period from January 1996 through April 2000.[4] Of the 77 IPOs, 45 issues initially began trading on the Taiwan Stock Exchange and 32 issues on the over-the-counter (OTC) market. We acquire the sample data through the Chinese Securities Association.

Table 1 reports the summary statistics for our sample of 77 Taiwanese IPOs. The mean number of lots is 15,718.56 (the median is 11,680.00), with a range between 2,723.00 and 58,182.00. Of these lots, 7,929.13 lots (50.44%) are sold through auctions, while 7,761.21 lots (49.38%) through open offers. Underwriters absorb those not sold out.

[4] When we extend the sample period through December 2002, there are totally 88 IPO auctions. Results based on the 88 auctions are quantitatively similar to those based on the 77 auctions. Therefore, we hereafter only report results using the 77 auctions. Results using the 88 auctions are available from authors upon request.

Insert Table 1 about here

The mean quantity-weighted bidding price for winning bids is NT$78.41 (the median is NT$55.13), with a range between NT$457.01 and NT$19.09. The maximum price is more than 20 times of the minimum price. On the other hand, the mean quantity-weighted bidding price for all bids is NT$71.80 (the median is NT$51.15), with a range between NT$434.12 and NT$17.79. The mean quantity-weighted bidding price for winning bids is about 10% greater than that for all bids.

Figure 2 shows the oversubscription (i.e., the total demand for shares divided by total supply of shares) of our IPO auctions. The mean oversubscription is 3.94 (the median is 3.30), with a range between 17.20 and 0.39. Investors bid aggressively for some issues, pushing the oversubscription up to 17.20 times the number of shares offered for auctions. However, investors barely subscribe to auctioned shares in some issues, which are associated with an oversubscription of lower than two.[5]

Insert Figure 2 about here

We also consider another measure of oversubscription for different types of investors (i.e., institutional vs. retail and large vs. small). The mean oversubscription for institutional bids is 0.81, while it is 3.13 for retail bids. On the other hand, the mean oversubscription for large bids (i.e., those with a bidding value of greater than NT$ 2 million) is 2.68, while it is 1.27 for small bids.

The mean number of bids is 987.09 (the median is 645.00), with a range between 5,406.00 and 39.00. We also consider the number of bids submitted by different types of investors. The mean number of bids from institutional investors is 57.39, while it is 929.70 from retail investors. On the other hand, the mean number of bids from large investors is 208.56, while it is 778.53 from small investors.

For follow-on fixed-price offers, the mean offer price is NT$ 64.46 (the median is NT$ 51.00), with a range between NT$ 16.50 and NT$ 375.00.

[5] Investors undersubscribed to one issue in our sample, Mirle Automation.

IV. Information from Investors' Bids

Information from investors' bids includes the winning bids, the identity of the bidders, the number of shares subscribed in each individual bid, and the bidding price for each individual bid.

Following the spirit of Cornelli and Goldreich (2003), we normalize the quantity-weighted average bidding price relative to the initial price range. Formally, the normalized quantity-weighted bidding price (hereafter NQWP) for winning bids is equal to (Pw – Pmin)/(Pmax – Pmin), while the NQWP for all bids is equal to (Pa – Pmin)/(Pmax – Pmin); Pw and Pa are, respectively, the quantity-weighted average bidding price for winning bids and for all bids; Pmax and Pmin (the minimum acceptable price) are, respectively, the maximum and the minimum of the initial price range set by underwriters. The NQWP is above one when the quantity-weighted average bidding price is above the maximum of the initial price range.

We also normalize the price difference between the quantity-weighted average bidding price and the open offer price relative to the open offer price. Formally, the percentage price difference (hereafter PPD) for winning bids is equal to (Pw – Po)/Po, while the PPD for all bids is equal to (Pa – Po)/Po; Pw and Pa are, respectively, the quantity-weighted average bidding price for winning bids and for all bids, and Po is the open offer price.

When the NQWP is large, information reveals that the offering is a good one; for, if two IPOs have the same price range and one of them has an NQWP greater than the other one, it reflects that bidders assign to the former a valuation higher than the latter. Similarly, when the PPD is large, information reveals that the offering is a bargain.

Insert Figure 3 about here

Panel A of Figure 3 is a histogram of NQWPs for winning bids. The histogram indicates that of the 77 IPOs, 63 have an NQWP of greater than one, suggesting that these offerings are good ones. On the other hand, Panel B of Figure 3 is a histogram of NQWPs for all bids. The histogram indicates that of the 77 IPOs, 47 have an NQWP of greater than one.

Panel A of Figure 4 is a histogram of PPDs for winning bids. The histogram shows that of the 77 IPOs, 20 have a PPD of greater than 25%, suggesting that these offerings are bargains. On the other hand, Panel B of Figure 4 is a histogram of PPDs for all bids. The histogram shows that of the 77 IPOs, only eight issues have a PPD of greater than 25%.

Insert Figure 4 about here

Another piece of information useful to investors is the elasticity of the demand. If there are many bidding prices close to each other, then the demand is elastic. On the contrary, if there are only a few and dispersed bidding prices within the same price interval, the demand is inelastic. Kandel et al. (1999) argue that the elasticity information revealed in an auction includes price-relevant information, which cannot be extracted from the auction clearing price alone. High demand elasticity may be considered "good news" since it may not only reflect more accurate investor information about the payoff of the security, but also imply higher liquidity in aftermarket trading.

Table 2 reports the summary statistics of NQWP, PPD, and four indicators of the demand elasticity. The mean NQWP for winning bids is 1.56 (the median is 1.28), while it is 1.22 (the median is 1.06) for all bids, reflecting that the initial price range specified by underwriters is relatively low compared to the market's pre-auction expectation of the issue value.

Insert Table 2 about here

The mean PPD for winning bids is 0.20 (the median is 0.09), with a range between 1.59 and 0.00, suggesting that many offerings are bargains. The mean PPD for all bids is 0.09 (the median is 0.03), with a range between 0.22 and –0.10.

We compute the elasticity at the auction clearing price (and the quantity-weighted average bidding price) for winning bids and measure it over an interval from the clearing price (and the quantity-weighted average bidding price) to a price of 1% or 3% higher. Regardless of the price interval used, the mean elasticity at the auction clearing price is higher than that at the quantity-weighted average bidding price. When measured on the interval with a price of 1% higher, the mean elasticity is 39.22 at the clearing price and it is 37.05 at the quantity-weighted average bidding price. When measured on the interval with a price of 3% higher, the mean elasticity is 21.31 at the clearing price and it is 20.94 at the quantity-weighted average bidding price.

V. Public Information and Investors' Bids

Draho (2001) argues that public information generated by previous IPOs creates incentives for investors. In other words, investors may condition their decisions to purchase on public information. In addition, Cornelli and Goldreich (2003) find that investors' bidding prices are affected by public information, such as industry IPO activity, industry factor, and the size of a firm (as captured by sales). We investigate the effect of public information on investors' bids in the auction setting as follows.

1. Public information variables

We examine three types of public information: firm characteristics, stock market conditions, and initial returns of other contemporaneous IPOs in our sample period. For firm characteristics we include *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.

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 auction's beginning date. The weights are three for the most recent month, two for the next, and one for the third month before the auction's beginning date. We then divide this weighted sum by six to get a weighted monthly market return.

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

Table 3 presents the summary statistics for the public information variables. The mean market index return before the auction period is 0.46%, with a range between –12.38% and 21.36%. On the other hand, the mean initial return of other contemporaneous IPOs is 19.03%, with a range between –1.40% and 66.03%. The mean amount of annual sales (in logarithm) is NT$14.66 million, while there are 41 high-tech firms in our sample.

Insert Table 3 about here

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2. Public information and investors' bids

We investigate whether public information influences investors' bidding behaviors in IPO auctions. We capture public information with *Ir_cipo*, *Mkt_rtn*, *Ln_sale*, and *Hi_tech*. *Ir_cipo* is the initial return variable of other contemporaneous IPOs; *Mkt_rtn* is the market index return variable prior to the auction period; *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 presents the regression results for winning bids, showing that investors indeed incorporate public information into their bids.[6] Regression 1 indicates that both *Ir_cipo* and *Hi_tech* have a positive and significant impact on investors' bidding prices, suggesting that investors 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 prices for large firms. On the other hand, *Mkt_rtn* has a positive but not significant impact on investors' bidding prices, suggesting that when investors submit their bids, they consider more the performance of other contemporaneous IPOs than the performance of the overall stock market.

Insert Table 4 about here

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6 The results based on the NQWP for all bids are qualitatively similar to those based on the NQWP for winning bids.

Regression 2 in Table 4 shows that the initial return variable has a very strong influence on the oversubscription of auctions, suggesting that investors also condition their demand for shares on the initial return of other contemporaneous IPOs. However, neither the firm size variable nor the high-tech dummy has a significant impact on investor oversubscription, suggesting that while investors submit higher prices for high-tech firms and/or small firms, they demand a small number of shares for these issues.

One explanation of this phenomenon is the threat of the “winner’s curse” investors might encounter in Taiwanese discriminatory auctions, where bidders pay what they bid. Although bidders are willing to bid a higher price for an IPO, they will likely demand a smaller number of shares so as to reduce the threat of the “winner’s curse.” High-tech firms and/or small firms tend to be associated with a higher risk of the asymmetric information; and this explains why for shares of these stocks bidders are willing to submit higher prices, but not large bids.

Regression 3 in Table 4 shows that *Ln_sale* has a positive and significant impact on institutional allocation; this result is somewhat contrary to what is reported in Regression 1, where *Ln_sale* has a negative and significant impact on investors’ bidding prices. One explanation for the difference is that institutional investors are more conservative than retail investors; and small firms and/or high-tech firms are more risky than large firms and/or traditional firms. Therefore, institutional investors bid aggressively for shares of large firms and/or of traditional firms. Another interpretation is that institutional investors may possess private information concerning the value of issuing firms; and their private information reveals that small firms and/or high-tech firms might be over-valued. Therefore, they abstain from participating in bidding for the shares of small firms and/or of high-tech firms.

VI. Investors’ Bids and Aftermarket Returns

Some authors show that IPO aftermarket returns can be predicted using information contained in investors’ bids. Kandel et al. (1999) and Liu et al. (2001) empirically document that the demand elasticity derived from the auction’s results can predict IPO underpricing.

In addition, Aggarwal et al. (2002) demonstrate that institutional allocation also predicts aftermarket returns. We investigate whether investors’ bids in IPO auctions contain information relevant to predicting aftermarket returns. If this is the case, then we ask a further question: Can the public information incorporated in investors' bids predict aftermarket returns?

We benchmark the aftermarket return in our IPO sample relative to the Taiwan Stock Exchange value-weighted index.[7] The market-adjusted cumulative aftermarket return is calculated with the offer price. As mentioned in Section II, the Securities Dealer Association announces the offer price on the next business day following the auction closing date, and the offer price is fixed until the IPO date. However, the stock market might move drastically during the period (pre-listing period) from the auction closing date to the IPO date. Therefore, market movements over the pre-listing period will affect the aftermarket return.

Suppose the offer price for a follow-on fixed-price offering is set at Po. If over the pre-listing period, the stock market rises by a rate r, then we expect that underwriters will try to adjust the offer price upwards if they can. However, once the offer price is set, underwriters cannot adjust it either upwards or downwards. Therefore, to correct for the impact of pre-listing market movements on the aftermarket return, we will subtract the stock market return over the pre-listing period from the aftermarket return for each individual issue.[8]

In Table 5 we present the results of an analysis that relates the aftermarket return to NQWP, oversubscription, and institutional allocation.

Insert Table 5 about here

Regression 1 in Table 5 shows that NQWP has a positive and significant impact on the aftermarket return. This regression has an adjusted R-squared of over 46%, suggesting that NQWP can explain a huge degree of variations in IPO underpricing. We further verify the extent to which the aftermarket return can be predicted by the fitted portion of and the residual portion of NQWP, which are derived from Regression 1 of Table 4.

Regression 6 in Table 5 shows that not only the fitted NQWP but also the residual NQWP predicts the aftermarket return. The result indicates that the

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[7] 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 aftermarket return reported here is the cumulative market-adjusted return until the day the limit is not hit.

[8] This subtraction also accordingly eliminates the effect of public information known over the pre-listing period on the aftermarket return.

public information incorporated in investors' bids can predict the aftermarket return, suggesting that underwriters have not fully incorporated public information known before the auction period into the initial price range they set.

Regression 2 in Table 5 relates the aftermarket return to oversubscription. The result shows that the variable of oversubscription has a positive and significant impact on the aftermarket return. Regression 7 relates the aftermarket return to the fitted oversubscription and the residual oversubscription, showing that the fitted oversubscription too predicts the aftermarket return.

Regression 3 relates the aftermarket return to demand elasticity. We use the demand elasticity measured at the clearing price (up to a price of 3% higher). The result shows that the variable of demand elasticity has a positive and significant impact on the aftermarket return, which is consistent with Kandel et al. (1999) and Liu et al. (2001).

Kandel et al. explain this in two ways. First, elastic demand might reflect more accurate investor information about the value of the issue and hence a lower risk premium. Second, elastic demand might also indicate high future liquidity, which in turn implies lower transaction costs. Their explanations are also applicable to our results.

Regression 4 in Table 5 relates the aftermarket return to NQWP, oversubscription, and demand elasticity. The results show that NQWP and demand elasticity have a positive and significant impact on the aftermarket return, but the coefficient of the variable of oversubscription becomes insignificant

The insignificance of the oversubscription variable suggests that the NQWP variable accounts for the effect of the oversubscription variable on the aftermarket return; for the NQWP variable abstracts not only the quantity-relevant information but also the price-relevant information from investors' bids, while the oversubscription variable only abstracts the quantity-relevant information.[9]

Regression 5 in Table 5 shows that the variable of institutional allocation has a positive and significant impact on the aftermarket return, while the coefficient of the demand elasticity variable becomes insignificant, suggesting that the NQWP variable and the variable of institutional allocation have jointly accounted for the effect of the demand elasticity variable on the aftermarket return.

Regression 8 in Table 5 shows that the residual institutional allocation has a

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9 We thank one referee for suggesting this explanation.

positive and significant impact on the aftermarket return, suggesting that institutional investors might have better information than retail investors.

Finally, we investigate whether public information can predict the residual aftermarket return not explained by the information variables of NQWP, oversubscription, demand elasticity, and institutional allocation. If our public information variables can predict the residual aftermarket return, then investors have not incorporated all the price-relevant public information into their bids.

We, first, use the results of Regression 5 in Table 5 to derive the residual aftermarket return. We then regress this residual aftermarket return on our four public information variables: the market index return (*Mkt_rtn*) prior to the auction period, the initial return of contemporary IPOs (*Ir_cipo*), the size of a firm (*Ln_sale*), and the high-tech dummy (*Hi_tech*) (t-statistics in parentheses):

$$\text{Residual Aftermarket Return}_i = \underset{(0.14)}{0.044} + \underset{(0.67)}{0.003}\, Mkt\_rtn_i - \underset{(-0.32)}{0.001}\, Ir\_cipo_i$$

$$- \underset{(-0.57)}{0.024}\, Hi\_tech_i - \underset{(-0.08)}{0.002}\, Ln\_sale_i$$

Adjusted $R^2 = -0.046$.

The result shows that the residual aftermarket return is unrelated to any of the public information variables, suggesting that investors have incorporated in their bids all the information reflected in our public information variables. The evidence together with the result in Regression 8 of Table 5 suggests that our public information variables are relevant to predicting the aftermarket return only insofar as the information has been incorporated in investors' bids.

VII. Conclusion

Our examination of investors' bids in Taiwanese discriminatory auctions indicates that investors have incorporated public information known before the auction period in their bids. We, particularly, find that the initial return of other contemporaneous IPOs affects investors' bidding prices and oversubscription of auctions. The industry factor and the size of a firm, as captured by sales, also affect investors' bidding prices. The results indicate that investors, on average, condition their bidding prices on the industry factor, the size of a firm, and the initial return of other contemporaneous IPOs.

We also discover that investors' bids contain information relevant to predicting the aftermarket return. Investors' average bidding price can predict the aftermarket return. The fact that the public information incorporated in investors' bids predicts the aftermarket return indicates that underwriters have not fully incorporated public information known before the auction period into the auction base price they set.

Furthermore, the variable of institutional allocation too predicts the aftermarket return, indicating that institutional investors might have better information concerning the value of IPO shares.

Finally, we find that our public information variables are relevant to predicting the aftermarket return only insofar as the information has been incorporated in investors' bids.

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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 Exchanges

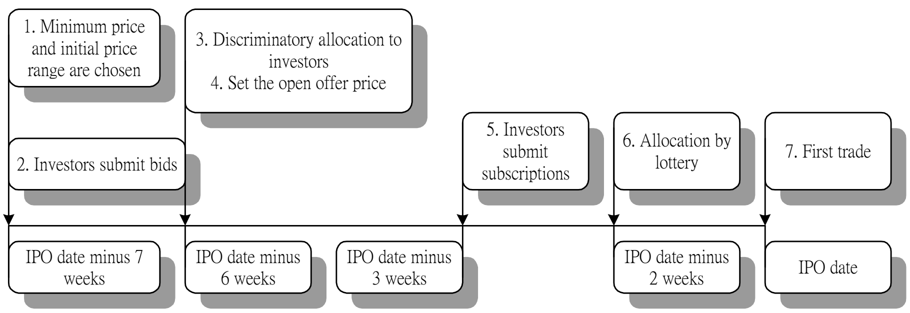
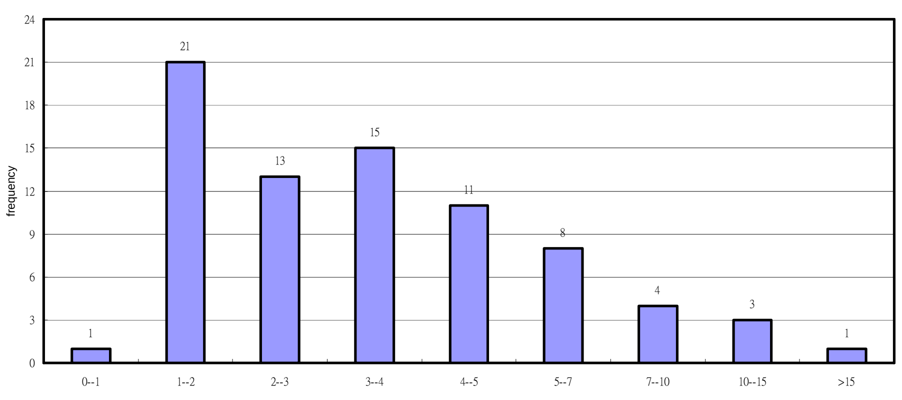


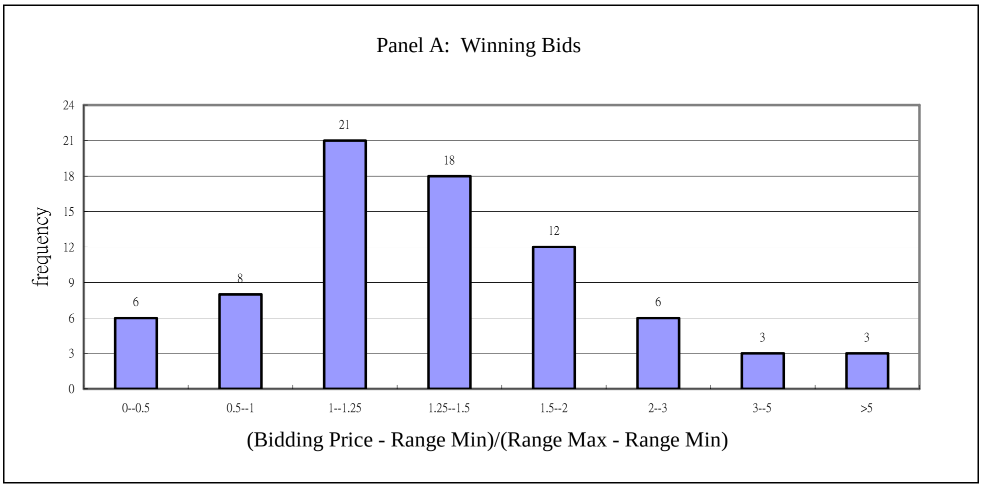
Figure 2
Oversubscription in IPO auctions

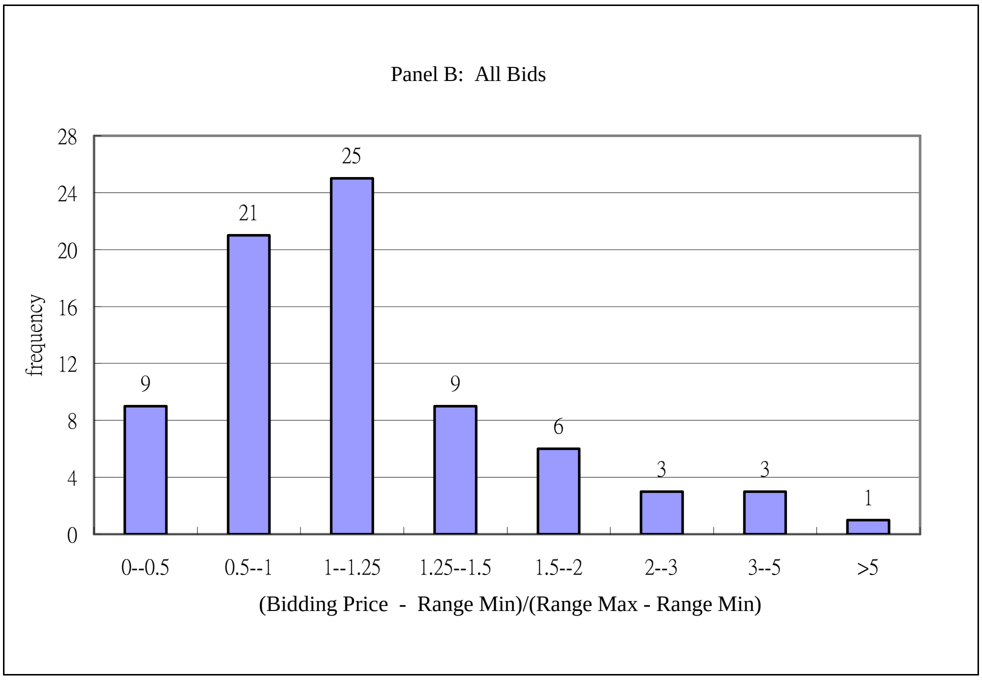


This histogram displays the oversubscription, computed at the minimum price, of the 77 IPOs. Oversubscription is defined as the total demand for shares divided by the total supply of shares. The mean oversubscription is 3.94 and the median is 3.30.

Figure 3

Normalized quantity-weighted bidding prices: Winning bids vs. all bids

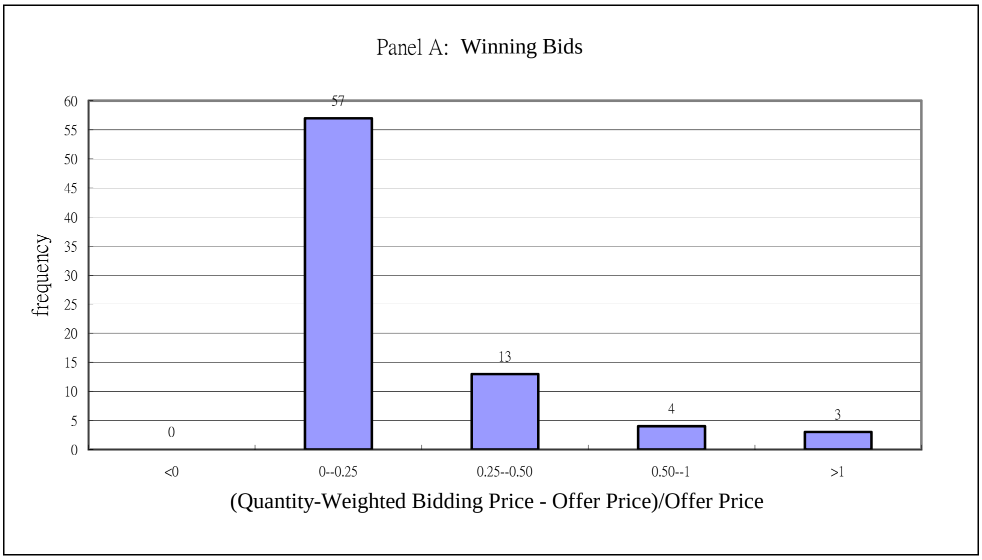


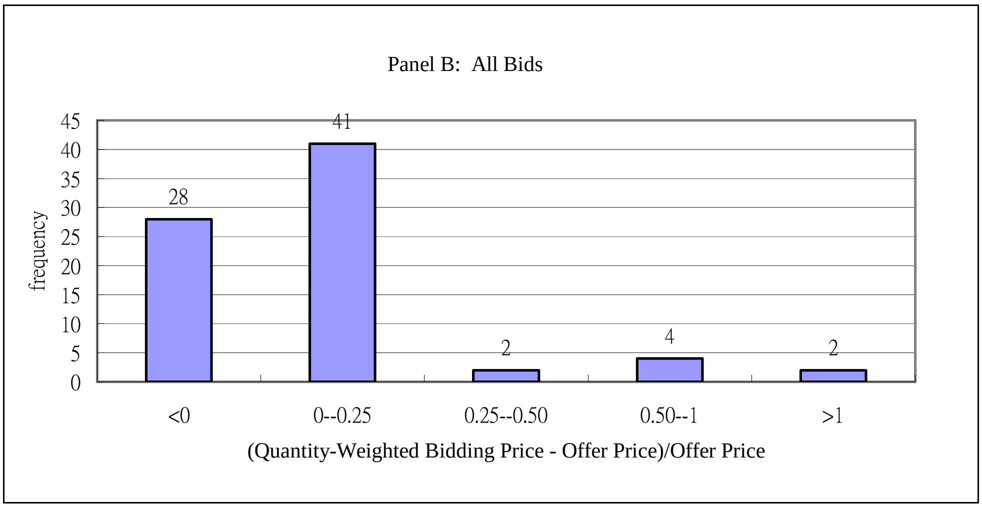


The first histogram shows the distribution of the NQWPs for winning bids for 77 IPO auctions and the second shows the distribution of the NQWPs for all bids.

Figure 4

Percentage price differences between offer prices and quantity-weighted bidding prices: Winning bids vs. all bids





The first histogram shows the distribution of the PPDs for winning bids for 77 IPO auctions and the second shows the distribution of the PPDs for all bids.

Table 1

Summary statistics for 77 IPOs

The sample contains 77 IPO auctions over the period from January 1996 through April 2000. Of the 77 IPOs, 45 initially began trading on the Taiwan Stock Exchange and 32 on the Over-the-Counter market. The quantity-weighted bidding price is calculated for winning bids and for all bids. Oversubscription is the total demand of shares divided by the total supply of shares, where demand is measured at the lowest bidding price. Large bids are those with a bidding value of greater than NT$2 million.

Items	Mean	Std Dev	Maximum	Minimum	Median
Lots for IPO	15,718.56	12,911.72	58,182.00	2,723.00	11,680.00
Lots put in auctions	8,001.39	6,942.48	38,788.00	1,362.00	5,840.00
Lots sold in auctions	7,929.13	6,872.41	38,788.00	1,362.00	5,840.00
Lots put in open offers	7,789.43	6,265.43	28,014.00	1,361.00	5,840.00
Lots sold in open offers	7,761.21	6,288.72	28,014.00	1,361.00	5,840.00
Lots unsold	28.22	247.64	2,173.00	0.00	0.00
Quantity-weighted bidding price (NT$)					
Winning bids	78.41	65.05	457.01	19.09	55.13
All bids	71.80	59.87	434.12	17.79	51.15
Oversubscription in auctions	3.94	2.98	17.20	0.39	3.30
Institutional bids	0.81	0.68	3.12	0.00	0.60
Retail bids	3.13	2.65	16.14	0.33	2.66
Large bids	2.68	1.68	7.40	0.06	2.17
Small bids	1.27	1.71	9.84	0.11	0.75
Number of bids in auctions	987.09	1,120.08	5,406.00	39.00	645.00
Institutional bids	57.39	65.01	342.00	0.00	42.00
Retail bids	929.70	1,072.90	5,180.00	39.00	599.00
Large bids	208.56	228.42	1,173.00	1.00	126.00
Small bids	778.53	941.16	4,528.00	22.00	528.00
Open offer price (NT$)	64.46	49.15	375.00	16.50	51.00

Table 2

The demand elasticity and normalized prices

The sample contains 77 IPOs from January 1996 through April 2000. $e_{1\%}(P_C)$ ($e_{3\%}(P_C)$) is the elasticity computed from the auction clearing price to a price of 1% (3%) higher. $e_{1\%}(P_W)$($e_{3\%}(P_W)$) is the elasticity computed from the quantity-weighted bidding price for winning bids to a price of 1% (3%) higher. NQWP (winning bids) is the normalized quantity-weighted bidding price for winning bids, which is equal to (Pw – Pmin)/(Pmax – Pmin); Pw is the quantity-weighted average bidding price for winning bids; Pmax and Pmin are, respectively, the maximum and the minimum of the initial price range specified by underwriters. NQWP (all bids) is the normalized quantity-weighted average bidding price for all bids, which is equal to (P_A – Pmin)/(Pmax – Pmin); P_A is the quantity-weighted average bidding price for all bids; Pmax and Pmin are, respectively, the maximum and the minimum of the initial price range specified by underwriters. PPD is the price difference between the quantity-weighted average bidding price and the open offer price relative to the open offer price.

Items	Mean	Std Dev	Maximum	Minimum	Median
$e_{1\%}(P_C)$	39.22	27.01	96.25	2.16	32.49
$e_{3\%}(P_C)$	21.31	9.03	33.33	2.25	22.76
$e_{1\%}(P_W)$	37.05	26.96	98.04	0.00	34.74
$e_{3\%}(P_W)$	20.94	9.18	33.33	0.00	22.17
NQWP (winning bids)	1.56	1.20	7.87	0.11	1.28
NQWP (all bids)	1.22	0.87	5.57	0.11	1.06
PPD (winning bids)	0.20	0.31	1.59	0.00	0.09
PPD (all bids)	0.09	0.22	1.05	-0.10	0.03

Table 3

Descriptive statistics for public information variables

This table reports the descriptive statistics for four public information variables on 77 IPO auctions. *Ln_sale*, a variable proxy for firm size, is the natural logarithm of yearly sales preceding the IPO year. *Hi_tech* is a dummy variable equal to 1 if the firm is a high technology firm. *Mkt_rtn* (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 auction beginning date. *Ir_cipo* (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 auction beginning date.

Items	Mean	Std Dev	Maximum	Minimum	Median
Mkt_rtn (%)	0.46	6.67	21.36	-12.38	0.21
Ir_cipo (%)	19.03	18.07	66.03	-1.40	16.11
Ln_sale (NT$ million)	14.66	1.00	17.87	12.70	14.41
Hi_tech (number of firms)	41				

Table 4

Public information and investors' bids for 77 IPOs

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 oversubscription, and the institutional allocation. *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 natural logarithm of annual sales. Ln(Oversubscription) is the logarithm of total demand/supply of shares, where demand is measured at the lowest bidding price. NQWP (winning bids) is the quantity-weighted average bidding price normalized to the price range. Institutional allocation is the percentage of shares allocated to institutional investors.

Dependent Variable	NQWP(Winning bids)	Ln(Oversubscription)	Institutional Allocation
Independent Variable	Reg1	Reg2	Reg3
Intercept	3.67 (2.55)*	-0.24 (-0.22)	-0.57 (-1.81)
Mkt_rtn	0.02 (0.63)	-0.01 (-0.98)	0.01 (0.08)
Ir_cipo	0.03 (3.78)*	0.02 (5.22)*	-0.01 (-1.20)
Hi_tech	0.78 (3.33)*	0.14 (0.95)	-0.03 (-0.63)
Ln_sale	-0.22 (-2.16)*	0.06 (0.80)	0.06 (2.71)*
Adjusted R-squared	31.21%	24.54%	5.33%
N	77	77	77

* Significant at the 5% level.

Table 5
Aftermarket returns for 77 IPOs

This table reports regression coefficients (and White's(1980) heteroskedasticity-adjusted t-statistics in parentheses) for various model specifications. The dependent variable is the benchmarked aftermarket return adjusted backward to the auction closing date. NQWP is the normalized quantity-weighted bidding price for winning bids. Ln(Oversubscription) is the natural logarithm of total demand/supply of shares, where demand is measured with all bids. Institutional allocation is the percentage of shares allocated to institutional investors. $e_{3\%}(P_C)$ is the elasticity computed from the auction clearing price to a price of 3% higher. Fitted NQWP and Residual NQWP are, respectively, the fitted value and the residual value derived from Regression 1 of Table 4. Fitted Ln(Oversubscription) and Residual Ln(Oversubscription) are, respectively, the fitted value and the residual value derived from Regression 2 of Table 4. Fitted Institutional Allocation and Residual Institutional Allocation are, respectively, the fitted value and the residual value derived from Regression 3 of Table 4.

Independent variable	Reg1	Reg2	Reg3	Reg4	Reg5	Independent variable	Reg6	Reg7	Reg8
Intercept	0.50 (0.13)	6.23 (1.40)	8.21 (1.38)	-11.61 (-1.59)	-12.97 (-1.87)	Intercept	-0.77 (-0.17)	-8.31 (-0.98)	-21.67 (-1.87)
NQWP	13.92 (5.94)*			13.80 (6.76)*	13.29 (6.11)*	Fitted NQWP	14.74 (4.77)*		14.83 (2.60)*
Ln(Oversubscription)		14.07 (3.48)*		2.22 (0.68)	4.33 (1.40)	Residual NQWP	13.49 (4.62)*		12.83 (4.94)*
Institutional Allocation					32.38 (2.43)*	Fitted Ln(Oversubscription)		26.82 (3.38)*	6.11 (0.69)
$e_{3\%}(P_C)$			0.67 (2.18)*	0.46 (2.02)*	0.15 (0.69)	Residual Ln(Oversubscription)		8.99 (1.93)	3.21 (0.85)
						Fitted Institutional Allocation			53.27 (1.09)
						Residual Institutional Allocation			31.18 (2.33)*
						$e_{3\%}(P_C)$			0.15 (0.70)
Adjusted R-squared	46.06%	14.42%	5.09%	48.36%	51.83%		45.42%	18.49%	50.28%
N	77	77	77	77	77		77	77	77

* Significant at the 5% level.