行政院國家科學委員會專題研究計畫　成果報告

IPO 之銷售機制與上市後股價行為之關聯性—為何競價拍賣會失去市場佔有率？

計畫類別：個別型計畫
計畫編號：NSC93-2416-H-216-003-
執行期間：93 年 08 月 01 日至 94 年 07 月 31 日
執行單位：中華大學財務管理學系

計畫主持人：徐政義

計畫參與人員：盧以誠、孔秀琴

報告類型：精簡報告

處理方式：本計畫可公開查詢

中　華　民　國 94 年 10 月 12 日

行政院國家科學委員會補助專題研究計畫 ■ 成 果 報 告
□期中進度報告

IPO 之銷售機制與上市後股價行為之關聯性
－為何競價拍賣會失去市場佔有率？

IPO Selling Mechanisms and Aftermarket Price Behavior: Why Have Auctions Been Losing Market Share?

計畫類別：■ 個別型計畫　　□ 整合型計畫
計畫編號：NSC 93 － 2416 － H － 216 － 003 －
執行期間：　93 年 8 月 1 日至　94　年　7　月　31　日

計畫主持人：　徐政義　中華大學財管系 副教授
計畫參與人員：盧以誠　中華大學財管系 講師
　　　　　　　孔秀琴　中華大學經管所 碩士班研究生

成果報告類型(依經費核定清單規定繳交)：■精簡報告　□完整報告

處理方式：除產學合作研究計畫、提升產業技術及人才培育研究計畫、列管計畫及下列情形者外，得立即公開查詢
□涉及專利或其他智慧財產權，□一年□二年後可公開查詢

執行單位：中華大學財務管理學系

中　華　民　國　94　年　8　月　1　日

摘要

本文針對 57 家臺灣的新上市公司，檢視其上市後初期的波動性，此 57 家 IPOs 中，有 25 家採用競價拍賣，另外的 32 家採用傳統的固定價格來承銷股票。本文計算上市初期之波動以及訂價錯誤，發現採用競價拍賣的 IPOs 均顯著地高於傳統的固定價格法。針對 25 家採用競價拍賣的 IPOs 進一步分析，發現上市初期之波動以及訂價錯誤均與加權平均的得標價格成正向相關，而加權平均的得標價格主要是受到投資人參與熱度的影響，尤其是散戶的影響最大。散戶過度的追高，拉抬了加權平均的得標價格。本文的實證結果支持了資訊產生理論，即競價拍賣所產生的資訊量，將低於傳統的固定價格法，此說明了為何競價拍賣會失去市場佔有率的原因。

關鍵詞：新上市公司；競價拍賣；固定價格承銷；波動性

Abstract

We examine aftermarket volatility for 57 Taiwanese IPOs under discriminate auction compared to fixed-price offering. We find that auctions in IPOs have higher aftermarket volatility and pricing errors than fixed-price offerings. Focusing on 25 auction samples, we find that aftermarket volatility and pricing errors in IPOs are positively associated with the average price of winning bids. The average price of winning bids is determined by the total demand for new shares, especially those from retail investors. It is retail investors rather than institutions that bid up the auction price. Our results support the view of information production theory that auctions lead to strictly less information production relative to fixed-price public offerings. This is why auctions have lost market shares over time.

Keywords: Initial public offerings; Auctions; Fixed-price offerings; Volatility

1. Introduction

In many countries, a new issuer can freely choose from at least two of the three major selling mechanisms to sell shares in the IPO market: auction, bookbuilding, and fixed-price public offering. Bookbuilding is the primary method in the U.S., but controversies have arisen that mainly focus on the higher underpricing and allocation practice of favoring institutional investors. Some have argued that new issuers should use an auction to sell new shares to everyone who bids the highest price.[1] Meanwhile, the auction method had been adapted before in many European and Asian countries to sell IPOs. Today it is increasingly being replaced either by fixed-price public offering or by the bookbuilding methods. The auction, which might be a potential competitor of the bookbuilding method in United States, has actually been losing market shares around the world.

IPO information production theory, as is discussed in Chemmanur and Liu (2003) and Sherman (2003), predicts that although auctions have lower expected underpricing, they have less information production during the offerings. If less information have been incorporated into the issuing price, it is likely to lead to more volatility and less efficiency in aftermarket trading from the date the new issue begins trading to the date that its true value is revealed. Thus, if an issuer cares only about the one-shot sale in the IPO stage, he/she prefers auction to sell new shares, but if this issuer cares not only about the IPO proceeds but also the security value in the aftermarket, he/she would choose fixed-price offering or bookbuilding, being hopeful that the information fully incorporated into the offering price will mean this offering has lower volatility and higher efficiency in aftermarket trading. Whereas information production theory has been modeled well in theoretical papers regarding the choice among selling mechanisms, there is to our best knowledge no empirical work that has yet been devoted to test the information production theory. The open question is whether, on average, auctions in IPOs have higher volatility and less efficiency in aftermarket trading. In this paper, we attempt to shed light on this issue.

Since no historical price is observed and information about the true value of a new issue is asymmetric, determining the price of new shares precisely is a task for

---

[1] An example is the discussions for the IPO of Internet search giant Google. In Kuchinskas (2004): "…Will Google use the so-called book-building method, in which lead investment bankers set the price behind closed doors, then use shares to reward favorite clients? Or will it embrace the spirit of the Internet and open its arms – and its IPO shares – to all the little guys that love it?…By auctioning all or part of the opening shares, at least individual investors would get a shot at a piece of the offering." Because of the reduction in underpricing, fairness, and firm characteristic (as a Internet service provider), Kuchinskas suggests that Google should consider using auction method to sell its IPO shares.

underwriters, issuers, and investors. The pricing procedures are quite different among bookbuilding, auctions and fixed-price offerings. In the bookbuilding selling mechanism, investment banks hold a road show to stimulate investors' interest and build a demand schedule for reference when they determine the initial price. They then determine the offering price and allocate new shares to investors according to their own discretion. Therefore, the underwriters' role in bookbuilding is the most active and important among the major three selling mechanisms. In fixed-price offerings, underwriters set the issuing price, investors submit their bids, and underwriters then allocate IPO shares based on predetermined allocation rules. Basically, fixed-price offerings favor retail investors most (see, e.g., Ljungqvist and Wilhelm (2002)).

In contrast, under the auction method, underwriters typically have little influence in allocating new shares and the decision of the issuing price. Underwriters set the base price for auctions in IPOs, and then investors submit their sealed bids for a set number of shares at a set price. New shares are allocated to investors, those who bid the highest price, and the prices the winners pay are what they bid (for discriminatory auction) or are the clearing price (for uniform price auction).[2]

Benveniste and Spindt (1989) modeled the bookbuilding procedure and argue that, in order to collect true information about the stock and to price the issue more accurately, investment banks will favor investors who truthfully reveal information when allocating shares. Underpricing and allocating more shares of a hot issue are rewards that are given to those investors. Therefore, the bookbuilding method can mitigate information asymmetry of the true value for a new issue.

The facts of underpricing and favoring institutional investors in bookbuilding raise some controversies about "leaving too much money on the table" and "unfairly treating retail investors". Loughran and Ritter (2002) demonstrate that bookbuilding IPO's underpricing, an indirect cost for issuers, is higher than it should be. On the one hand, the high underpricing reduces the investment banks' revenue because of the fixed percentage of the underwriting fee on IPO proceeds, but on the other hand, it increases their indirect profits because they receive higher commissions in brokerage revenue from investors who intentionally improve their chance for being allocated shares in hot IPOs. Loughran and Ritter argue that underpricing is a form of indirect compensation to underwriters.

Ausubel (2002), based on results from the economic theory of auction, argues that

---

[2] A dirty auction is an exception. It is an auction where the issuer is allowed to choose the offering price below the clearing price. Refer to the cases in French IPOs (Derrien and Womack (2003)) and in Japanese ones (Kaneko and Pettway(2003)).

the bookbuilding method fails to allocate new shares efficiently. He proposes that issuers and underwriters should adopt the auction method to sell IPO shares because it would assign shares to the investors who bid the highest, and simultaneously maximize IPO proceeds.[3] Indeed, the empirical evidence from French and Japanese IPOs suggests that the amount of money left on the table for auctions in IPOs is significantly lower than those in bookbuilding IPOs (See Derrien and Womack (2003) and Kaneko and Pettway(2003)).

The reduction of underpricing in auctions indicates that the average loss by issuing firms and insiders who sell their stake in the IPO is decreased. If the benefits outweigh the implicit cost, auctions should gain more IPO market shares over bookbuilding or fixed-price offerings. But it is inconsistent with the trend that auctions gradually loose IPO market shares. Some theories, positing the merits of bookbuilding or fixed-price offering and pointing out the flaws of IPO auctions, may provide explanations. For example, Sherman (2000) proposes that the long-term relationship between investment banks and investors helps underwriters to reduce the extent of failure risk. The relationship only exists in bookbuilding, where underwriters have more discretion to allocate new shares and to determine the issuing price. Benveniste, Ljungqvist, Wilhelm, and Yu (2003) find that underwriters tend to bundle IPOs to avoid some "weak" IPOs from being a failure in selling IPO shares. The explanation implies that the issuer and the underwriters in IPO auctions will have higher issuing risk than in bookbuilding.

The information production theory provides an alternative, not a mutually exclusive, hypothesis. Levin and Smith (1994) argue that auctions without restricting entrance will lead to aggressive bidding to bid up the price above the optimal. In this clearing price, informed investors are not compensated from the profits, therefore they will choose to deviate from participating in auction bidding.

Comparing an auction (uniform price) with fixed-price offering, Chemmanur and Liu (2003) show that the offering price emerging in an IPO auction, since each bidder will compete away much of the surplus from each other, will be able to support only a smaller number of informed entrants in the auction compared to the number of investors producing information in a fixed-price offering. Their model concludes that auctions

[3] Ausubel (2002) argues that auction methods can achieve two goals: one is efficiency, which is assigning items to the bidders who value them the most, and the other is IPO proceeds maximization, which is reducing the amount of money left on the table. Among many auctions, Ausubel proposes that the ascending auction is the best selling mechanism based on the two goals. Sealed-bid auctions are exposed to winner's curse because other investors' unfavorable information is unobserved when bidding, therefore a successful bidder is more likely to win a "lemon". Ascending auction provides bidders with continuous feedback about other bidder's action, it would mitigate the winner's curse and leads to more aggressively bid.

lead to strictly less information production relative to fixed-price public offerings.

Similarly, Sherman (2003) models bookbuilding, a discriminatory auction and a uniform price auction. She proposes that under bookbuilding issuers and underwriters have more control over the information expenditures by controlling allocation and underpricing, but they do not have this ability in auction methods, leading to the free-rider problem in IPO auctions. She concludes, therefore, that there will be less information acquisition in auctions of IPOs.

The assumptions, though, in Chemmanur and Liu (2003) and in Sherman (2003) are different[4]; the information production theory in these two papers predicts that auctions are suited only for selling high-quality Treasury bills but not for securities with a high extent of information asymmetry. Most of the IPO firms are young, small, and have a high extent of information asymmetry. If the information for the value of new shares is not produced efficiently and sufficiently in the IPO selling procedure, it will lead to more volatile and less efficient prices in aftermarket trading.

Some literature has been devoted to comparing initial returns under different selling mechanisms, e.g., Derrien and Womack (2003) and Kaneko and Pettway(2003), but so far there are few studies examining the aftermarket volatility and efficiency immediately following IPOs and there is no empirical analysis on the influence of selling mechanisms on the trading quality in the aftermarket.[5] Since there are two IPO selling mechanisms in Taiwan, which are auctions and fixed-price open offerings,[6] the Taiwanese IPO dataset provides a good opportunity to directly test the information production theory proposed by Chemmanur and Liu (2003), and also implied by the theoretical results in Sherman (2003).

Using a daily and intra-day dataset, we analyze volatility and efficiency in the

---

4 Chemmanur and Liu (2003) assume that insiders have information regarding the true value of the firm that outsiders do not have. Insiders have incentive to disseminate information to outsiders because it would lead to higher value in aftermarket trading. The assumption in Sherman (2003) is that no one has special information advantage over others. Information collection is costly, and underwriters and issuers hope the investors spend on information acquisition. Investment banks and issuers have incentives to extract valuable information from informed investors and aggregate the information into the offering price.

5 The work in Corwin, Harris, and Lipson (2004) is the exception. They investigate the liquidity changes of IPOs, all of them use bookbuilding method, in the aftermarket in the NYSE.

6 As we will introduce Taiwanese IPO selling mechanisms later, an auction in Taiwanese IPO is different from the settings in Sherman (2003) and the ones in Chemmanur and Liu (2003). First, the Chemmanur and Liu (2003) modeled the "uniform-price auction", while Taiwanese auction uses discriminatory method. According to the analysis in Sherman (2003), the information production results in discriminatory auctions is similar to uniform-price auctions. Second, the auction in Taiwan is actually a sequential hybrid sale: fifty percent of shares are put in auction to be sold, and the remaining shares are allocated using an open offer at offering price. Because the offering price in the open offer (the second stage) is determined by the result in auction (the first stage), the information cascades effect is strong in this sequential hybrid sale. Thus, the second stage will not help information production (Please refer to Hsu and Shiu (2003)).

30-day aftermarket immediately following the listing date for a sample of 57 IPOs listed on Taiwan Stock Exchange (TSE) between January 1998 and December 2000. In this period, auctions and fixed-price open offerings were approximately evenly used in Taiwanese IPOs. Of 57 samples, 32 issuers choose to employ fixed-price public offerings to sell their new shares, and 25 IPOs use auctions. We find that the auctions have higher volatilities and transaction costs than fixed-price offerings. Further analyzing the 25 auctions, we demonstrate that the aggressive participation in the auctions, most of which are from free riders, bid up the IPOs price.

Consistent with the prediction of the information production theory, we find that the enthusiastic participations in IPO auctions, especially those from retail investors, will bid up the auction price far above the optimal. At this price, it cannot afford enough incentive (or compensation) for informed investors to release their private information. The information production is neither sufficient nor efficient in auction IPOs, and information is not fully incorporated into their offering prices or the prices in the aftermarket immediately following the IPO. Therefore, auction IPOs have higher volatilities and transaction costs than fixed-price offerings.

Although the focus of this paper is on the comparison of information production between auctions in IPOs and fixed-price offerings in Taiwan, our results have some implications for the recent disputes of IPO selling methods in U.S. as well. New issuers will face the trade-off between the IPO proceeds and share values in the aftermarket.

This article is organized as follows. Section 2 introduces the sample and presents the descriptive statistics. Section 3 contains the empirical analysis of the influences of selling mechanisms on aftermarket volatility and efficiency. In section 4, we analyze the auction outcome. Section 5 reviews our conclusions and self-valuation.

2. Data

For the period from January 1998 to December 2000, there were 263 IPOs in Taiwan stock markets. Among the firms, 57 of them were listed on the Taiwan Stock Exchange (TSE) and 206 issuers went to Over-the-Counter (OTC) markets. Because the trading mechanisms of the aftermarket are different between the TSE and the OTC market, and the intra-day data in the OTC is not available, we delete 206 OTC firms from our sample. We start our sample from January 1998 since the intra-day data before 1998 is not available, and we end the research period in December 2000 because after that the number of auctions is scarce relative to fixed-price public offerings. We acquired the sample data through the Taiwan Securities Dealers Association (SDA). The bidding dataset in auction is also from SDA. The firm characteristics data and aftermarket trading data are from the Taiwan Economic Journal (TEJ), which is a popular dataset in Taiwan.

As shown in Panel A of Table 1, there are 32 new issuers who adopted the fixed-price method to sell their IPO shares, while 25 IPOs used auction. The mean IPO proceeds is NT$701 million for fixed-price offerings and NT$4,929 million for auction IPOs.[7] The issue price of fixed-price is NT$35.24, lower than auctions with NT$90.99. Auctions have higher sales and book value of assets and equity than fixed-price offerings. It seems that large firms tend to choose auctions, which is consistent with the prediction of Chemmanur and Liu (2003). It also seems that bidders in auctions bid up the issue price. The fractions of equity sold in IPO are not different between the two selling mechanisms, which is inconsistent with the theory of Chemmanur and Liu. A possible explanation is that the fraction sold in IPO is regulated by the Securities and Futures Commissions (SFC) and is designed to disperse ownership. The average age on fixed-price offerings is 21 years, vs. 15 years on auctions, suggesting that a young firm prefers the auction rather than the fixed-price method.

Panel B provides summary statistics of the bidding outcome for 27 auctions. On average, there are 19,816 lots put up for an IPO in each issue (the median is 9,125), with a range from 1,833 to 289,431 lots. The inflated number in the mean relative median is attributed to a large offering (*Chunghwa* Telecom).

Investors did bid quite high for most issues and abstained in only a few auctions. The average lots bid by institutions is 12,263, and is 20,313 by retailers. It mirrors the passion of retail investors in the Taiwan stock market. The mean in oversubscriptions by institutions (i.e., total institutional demand divided by total supply) is 0.83 (the median is 0.60) and oversubscription by retailers is 2.21 (the median is 2.27). In the total new shares, 28.23% are allocated to institutions and the remaining shares (71.77%) are allocated to retail investors.

Investors are shown to bid aggressively, pushing the average clearing price (NT$104.87) 65% higher than the mean in an auction base price (NT$63.46). On average, the *WAP* (i.e., the quantity-weighted average of the bidding price calculated from the winning bids) is NT$107.38 (the median is NT$101.88), with a range from NT$27.17 to NT$457.01. The mean in NWAP (i.e., the quantity-weighted average price of winning bids divided by the auction base price) is 1.66, with a range from 1.00

[7] The IPO proceeds both in the fixed-price and auction methods are calculated as the shares sold in IPO (the total shares for fixed-price offering and the shares auctioned plus the shares sold in the subsequent public offer for auction IPOs) multiply by the offering price. As we discuss earlier, the weighted average prices of winning bids are usually higher than offering price for auction IPOs, therefore the actual IPO proceeds in auctions are a little underestimated.

(indicating the quantity-weighted average winning price is equal to base price, this case is under-subscripted) to 2.50 (the quantity-weighted average winning price is 150 % higher than base price).

3. Selling mechanisms and aftermarket trading

3.1 Aftermarket volatility and efficiency measures

Because there is less information production produced in auctions, the information production theory predicts that auctions in IPOs would have higher volatility and less efficiency than fixed-price offerings in aftermarket trading. This subsection introduces the aftermarket volatility and efficiency measures.

Since there is a 7 percent daily limit imposed on the price movements of securities traded in Taiwan stock markets, security prices may continue to hit the limit many days following the listing day. The period from listing day to the first day on which the limit is not hit is called "honeymoon period". The mean of the honeymoon period is 4.74 days, with the range from 1 day to 33 days.

For each IPO, we retrieved the intra-day price dataset of 30 trading days after the "honeymoon" period. The stock price behaviors after the initial listing will be gradually affected by a firm's decision. The longer the window is, the higher will be the probability of a contamination on the data. This is why we used a cut-off of 30 days after the end of the "honeymoon period".

It is well known that U.S. underwriters stabilize the stock price in the aftermarket immediately following IPOs. Therefore, the transaction and return data in the U.S. is contaminated by stabilization activities. However, because law prohibits underwriters in Taiwan from stabilizing IPOs, our data are free from manipulation.

We employ several proxy measures for stock return volatility. These measures are the daily returns standard deviation, price high-low ranges, and relative price ranges (measured by dividing the price range by the quantity-average price). We also examine the intra-day (15-minute) price high-low range and relative price range. A higher return standard deviation, price range, and relative price range imply higher volatility. The high-low range can be interpreted slightly differently from the return standard deviation because the former is taken from two extreme (or outlying) observations. Note that the error in the intra-day dataset may cause the observed range to be wider than it should be. We have examined carefully the intra-day dataset and found no unusual data. The other issue is that the 7% price limit restricts stocks from moving to a higher or lower price to reflect their intrinsic value in the same day when they reach upper or lower price limits. When a stock hits its price limit, its stock prices are always stuck on the limit price, making the price range equal to zero. We delete the observation if the price reaches its limits. The empirical results are not quantitatively different if those observations are included.

The efficiency measure is the first order of serial correlation of the daily return. In a well-functioning market, information should be incorporated into the price fully and completely, so that there should be little serial correlation. A positive or negative autocorrelation might imply that prices incorporate information slowly or prices overreact to information. Both may stand for market inefficiency. We also calculate the standard deviation of pricing error by decomposing tick-by-tick prices into the intrinsic price and "noise". Hasbrouck (1993) suggests that high standard deviation of "noise" implies poor price quality; therefore the standard deviation of pricing error is also a proxy for inefficiency. In a VAR model for decomposing prices, we employ five lags in both equations.

Table 2 represents the descriptive statistics for volatility and efficiency measures. The average standard deviation of the daily return is 3.07% (median=3.02%). The mean in the daily high-low price range is NT$2.99 (median=NT$1.41), and the relative price range is 3.81% (median=3.84%). In the intra-day volatility measures, the mean in a non-overlapping 15-period high-low price range is NT$0.65 (median=NT$0.29). The relative price range is 0.83% (median=0.84%).

In efficiency measures, the mean in the absolute of the first-order serial correlation is 0.1846 (median=0.1752), and the mean in the standard deviation of noise is 0.23% (median=0.23%), with a range from 0.06% to 0.43%. Hasbrouck (1993) suggests that the expected transaction cost could be expressed as:

$$E|S_t| = \sqrt{2/\pi}\,\sigma_S \qquad (1)$$

where σ_S is the standard deviation of noise. Following this method, we calculate the expected transaction cost is 0.1835% for our sample in the aftermarket period.

3.2 Influence of selling mechanisms on aftermarket volatility and efficiency

In the information production theory, Chemmanur and Liu (2003) and Sherman (2003) argue that the issuers, based on their objective and firm characteristics, would choose the optimal selling mechanism. The choice of selling mechanisms is dynamic and *endogenous*. Consider an issuer with a low extent of information asymmetry (e.g., an IPO of public utilities firm). Because the benefit from the information production does not outweigh the cost of underpricing, the information production in the offering process is perhaps of less concern for this issuer than is the maximization of IPO proceeds. In such a case, the issuer would choose the auction method to sell new shares in order to gain higher IPO proceeds. If directly regressing the aftermarket trading measures on the choice of selling method, it would falsely conclude that auctions result in low volatility in aftermarket trading. That is, if ignoring the facts of the ex-ante optimal choice, one will fall into the trap of spurious empirical results, such as the higher-quality underwriters seemly underprice more in 1990s (see Habib and Ljungqvist (2001)).

Following Habib and Ljungqvist (2001) and Ljungqvist, Jenkinson, and Wilhelm (2003), we employ a two-stage least squares model to clarify the influence of selling mechanisms on aftermarket volatility and efficiency. In the first stage, we estimate the probit regression that the probability a firm choosing auction to sell its IPO shares (dependent variable = 1 if a firm uses auction). The independent variables are *fraction*, the fraction of the shares sold in IPOs to total shares outstanding before the IPO; *proceeds*, the logarithm of the IPO proceeds (NT dollars); and *Hi-tech*, which is a dummy if a firm is a hi-tech. Chemmanur and Liu (2003) predicts a positive sign in coefficients of the *fraction* and *proceeds* and a negative sign in the coefficient of *Hi-tech*, which indicates that a firm with a large fraction of shares sold in an IPO, large IPO proceeds, or low extent of information asymmetry, in equilibrium will prefer to choose the auction method.

We also add a variable, *Mr1_mon*, to control the effect of the recent market movement on the choice between selling methods. Loughran and Ritter (2002) find that there is a partial adjustment of the offer price not only with respect to private information, but also to public information, such as recent market movements that are readily available to all investors. In equilibrium, if the market is hot and the offer price, which is set by the underwriter in fixed-price offerings, only partially adjusts to market movement, the issuer would prefer to adopt the auction method to sell new shares, so as to gain higher IPO proceeds. But if the market declines, and the underwriter does not fully adjust the offer price in response to this decline, then the issuer might prefer a fixed-price offering.

The variable of recent market movement, *Mr1_mon*, is the average market index returns before the date of choosing the selling mechanism (one month before the beginning of the auction or fixed-price open offering sale), which is constructed as a 90-day weighted average of the buy-and-hold returns of the Taiwan Capitalization Weighted Price Index (TAIEX). The weights are three for the most recent 30-day return, two for the next period, and one for the third 30-day return.

The results for 57 sample IPOs are shown in equation (2) (The numbers in parentheses are White (1980) heteroscedasticity-consistent standard errors):

$$\text{Probit (=1 if auction)} = \underset{(4.805)}{-16.529} + \underset{(0.045)}{0.036}\ \mathit{Mr1\_mon} + \underset{(0.445)}{1.186}\ \mathit{Hi\text{-}tech} + \underset{(3.379)}{3.980}\ \mathit{fraction}$$

(standard error)

$$+ \underset{(0.231)}{0.745}\ \mathit{proceeds} \qquad (2)$$

McFadden R^2 = 33.39%, LR(χ^2) statistic = 26.098

In equation (2), the coefficient on *proceeds* is 0.745, 3.23 times its standard error, suggesting the possibility of choosing the auction method is positively associated with the IPO proceeds. It is consistent with the prediction in Chemmanur and Liu (2003) that a firm with larger IPO proceeds is more likely to care about the under-priced one-time sale. However, the coefficient on *fraction* is insignificant, implying that the fraction of shares sold in the IPO does not seem to affect the choice of selling mechanisms.

The coefficient on *Hi-tech* is 1.186, significantly different from zero at 1% the level, showing that hi-tech firms prefer the auction than the fixed-price method to sell their new shares. If *hi-tech* is a good proxy for information asymmetry, that is, if hi-tech firms have a higher extent of information asymmetry than traditional ones, our results are contrary to the prediction with the Chemmanur and Liu (2003). Another explanation for this result is that, because most of IPO firms in Taiwan use secondary shares, the founders of hi-tech firms are more anxious about the realization of profits from selling their shares in the IPO than the security value in the aftermarket.

Finally, the hotness of the secondary market does not seem to affect the choice of the selling mechanism. Because the focus of this paper is not on the determinants of ex-ante choice between selling mechanisms, we do not address more on this issue.

The dependent variables in the second stages are those measures for aftermarket volatility and efficiency discussed earlier. The first of the independent variables is the predicted probability of using the auction method, which is from the predicted value in the first stage in equation (2), and standing for the probability a firm will choose the auction method when the selling choice is exogenous. If auctions are expected to produce higher aftermarket volatility and lower efficiency, the coefficient on the predicted probability should be positive. The independent variables also include the measures of market volatility to control for the information arrival at the market level, and the effects of the market transaction quality on individual price behaviors. Finally, we add a control variable *cap*, which is a proxy for firm size and calculated as the logarithm of the market value of equity (NT$ millions) at the end of the "honeymoon period".

Table 3 shows the results of the second stage in the 2SLS model. Reg1 is the result for the standard deviation of daily return. The coefficient on *predicted probability*: *auction* is 0.9123, significant at 5 percent level. The coefficient of cap is negative but insignificant, showing the weak negative association of the firm size with the return standard deviation for our sample. The coefficient on *market return std. dev* is 0.6037, and statistically significant at the 5% level, suggesting the overall market volatility will spill over to individual stocks.

Reg2 and Reg3 in Table 3 report the estimates for the daily high-low price range and the relative price range. The regression explains the 46% and 27% variation in the daily high-low price range and relative price range, respectively. In both regressions, the coefficients on *predicted probability*: *auction* are positive and significantly different from zero. The results imply that auction IPOs have higher daily volatility than fixed-price offerings in the 30-day aftermarket immediately following the IPO, after controlling for the firm size, market condition, and the exogenous ex-ante choice.

Further analyzing intra-day volatility, Reg4 and Reg5 reports the results for a 15-minute high-low price range and relative price range. Again, the coefficients of *predicted probability*: *auction* in the two regressions are still positive and significant, indicating auction IPOs also have a higher intra-day volatility than fixed-price offerings. The result is robust no matter we use the daily return standard deviation, high-low range, relative price range, or intra-day high-low price range.

We next analyze the influence of the selling mechanism on aftermarket price efficiency. Reg6 of Table 3 reports the estimate result for the daily return autocorrelation. The insignificant coefficients on independent variables and low R-square suggest that the model poorly explains the variation of the absolute value of the autocorrelation.

The estimated result for the standard deviation of noise is represented in Reg7 of Table 3. The coefficient on *cap* is significantly negative, which is consistent with the findings in Hasbrouck (1993) that on average large firms have lower pricing errors, and therefore lower expected transaction costs. The coefficient of *predicted probability*: *auction* is 0.6132, with a standard error of 0.3428, marginally significant (p=0.0793). Using the method proposed by Hasbrouck (1993), we estimate the influence of choice between selling mechanisms on the standard deviation of pricing errors by assuming a representative firm that has a market value of equity NT$34,499 million (the mean of the sample), and the market standard deviation is 1.6788%. The expected transaction cost is

0.154% if this firm uses a fixed-price open offer. The cost rises to 0.215% if this firm employs the auction method. It indicates that on average auctions have 40 percent higher transaction costs than fixed-price offerings.

In summary, our empirical results show that auction IPOs have consistently higher volatility and transaction costs than fixed-price offerings. These findings are consistent with the predictions of the information production theory proposed by Chemmanur and Liu (2003) and Sherman (2003).

4. Analysis on auctions

The information production theory argues that, because the large numbers of bidders and their aggressive bidding, the clearing prices in auctions are too high to compensate the informed investors. Consequently, the auction IPOs have a higher volatility and lower efficiency in the aftermarket trading. If this is the case, then the auction outcome (i.e., the oversubscription and the average price of successful bids) is expected to be associated with the aftermarket volatility/efficiency. We next examine this relationship by analyzing 25 auctions.

4.1 The auction outcome and aftermarket outcome

Panel B of Table 1 has introduced the descriptive statistics for the bidding outcome of 25 auctions. On average, the total demand is 3.04 times the number of shares sold in auction. If these auctions sold at the IPO base price, then the auction method benefits the issuers by decreasing NT$870 million left on the table, or increasing by 69% the IPO proceeds.

The variables employed in this analysis for the auction outcome are *NWAP* (the normalized weighted average of winning bids), which is calculated as the weighted average price of the winning bids divided by the auction base price, and the *%ins* (percentage of shares allocated to institutional investors). The higher the *NWAP* means the more aggressive were the bids by investors. The *%ins* measures the institutional investors' interest in that issue: if institutional investors are interested in acquiring the new shares from an issue, they will bid aggressively and are allocated more shares. We also add *cap*, which is the logarithm of market value of equity, and market volatility measure (market return standard deviation and relative market index high-low range), to control for firm size and market conditions.

Table 4 reports the OLS results. The adjusted R-squares of four regressions are from 20.70% to 46.27%, showing that the independent variables well explain the variation of volatility and efficiency measures. In Reg1, the dependent variable is the daily return standard deviation. The coefficient on cap is negative, and it is positive for market return standard deviation, implying that a large firm tends to have low standard deviation of return, and a firm will have higher volatility when the market is more volatile. The coefficient for *NWAP* is positive and highly significant ($p<0.001$), indicating that a firm with higher *NWAP* will have higher standard deviation of return in the aftermarket. The coefficient for *%ins*, however, is not significant. The institutional allocation seems not to explain the variation of return standard deviation for auctions.

The dependent variables in Reg2 and Reg3 are daily and 15-minute relative high-low price range, respectively. Again, the coefficients for *NWAP* are highly significant ($p<0.001$ for both), but the ones on *%ins* are insignificant. The results suggest that a firm with a higher *NWAP* will produce a higher daily and intra-day relative price range.

Finally, the dependent variable in Reg4 is the standard deviation of noise. Consistent with the results in volatility measures, the *NWAP* still has a significant coefficient but *%ins* done not have. It seems that in an auction with a high *NWAP*, the aftermarket price tends to have high pricing errors.

The empirical results in this subsection, consistent with the prediction of information production theory, show that if investors aggressively bid in an auction and therefore bid up the price, this auction tends to have higher volatility and pricing errors. The bid-up price, which is above the optimal, will prevent the information about the value of the new equity from being produced and being incorporated in the aftermarket price. Consequently, auctions with higher bidding prices have a more volatile and a lower efficient price in the aftermarket.

4.2 Who bids up auction prices?

In finance literature, institutional investors are assumed to be informed investors, while retail investors are uninformed. Institutions are different from retail investors, in that their scale and resources should make it more likely that they are informed. Analyzing a bookbuilding IPO, Cornelli and Goldreich (2001), Ljungqvist and Wlhelm (2002), and Aggarwal, Prabhala, and Puri (2002) found that institutions do receive preferential allocations.

In the early analysis, we find that the auctions with a high average price of successful bids will have poor trading quality in the aftermarket immediately following the listing date. Who bids up the auction price? We address the issue by examining the association of the *NWAP* and the demand of two types of investors.

Table 5 represents the analysis. The dependent variable is *NWAP*. In Reg1 we regress the NWAP on *ln_oversub(all bids)*, which is the logarithm of one plus the oversubscription by all bids and captures the demand from all bids. The coefficient of *ln_oversub(all bids)* is positive and statistically different from zero (P<0.001). It suggests the positive association of the average successful bidding prices and total demand in auctions. This relation is quite intuitive: the higher demand creates higher clearing prices.

Reg2 and Reg3 examine the influences of demands by different investors' types (institutional and retail investors) on the *NWAP*. The insignificant coefficient of institutional demand (*ln_oversub(institutional bids)*) and the low R-squared (adjusted R^2 is 0.95%) imply that the bids from institutional investors do not explain the variation of the weighted price of winning bids. On the other hand, the coefficient for *ln_oversub(retail's bids)* is positive and highly statistically significant, and R-squared in Reg3 is 49.76%, suggesting that the *NWAP* is positive associated with the demand from retail investors' bids. Reg4 includes both the demands of institutional and retail investors. The coefficient for institutional demand, again, is insignificantly negative, and the one on retailers' demand is statistically positive. The empirical results indicate that the high bid-up prices in auctions are mainly driven by retail investors' demands.

In sum, we find that retail investors tend to overwhelmingly subscribe some auctions, creating high oversubscritiopn and consequently producing high auction prices. We find no evidence that institutional investors bid up the auction price.

5. Conclusions and Self Evaluation

We examine the volatility and efficiency measures in a 30-day aftermarket immediately following the listing dates for 57 IPOs listed on the Taiwan stock exchange from January 1998 to December 2000. In the sample, the volatility and efficiency measures of 25 discriminate auctions and 32 fixed-price offerings are compared. After controlling for endogenous choice between selling mechanisms, we find that auction IPOs have a higher aftermarket volatility and pricing errors than fixed-price offerings.

Focusing on 25 auction samples, we find that IPOs with a high average price of winning bids have high aftermarket volatility and pricing errors. The average price of the winning bids is positively correlated with the total demand for new shares, especially those from retail investors. It is the retail investors that bid up the auction prices.

We conclude that enthusiastic participations in IPO auctions, especially those from retail investors, will bid up the auction price far above the optimal. At this price, profits cannot afford informed investors to release their private information regarding the value of stocks. Consequently, auction IPOs have higher volatilities and transaction costs than fixed-price offerings. Our results support the view of information production theory that auction leads to strictly less information production relative to fixed-price public offerings.

This work enhances our understanding why auction method has been losing market shares around the world. The participants in this research have learned the theoretical and empirical works regarding the IPO and intra-day study. These results are potentially published in the leading Journals.

References

Aggarwal, Reena, Nagpurnanand Prabhala, and Manju Puri, 2002. Institutional Allocation in Initial Public Offerings: Empirical Evidence. Journal of Finance 57, 1421-1442.

Ausubel, Lawrence, 2002. Implications of Auction Theory for New Issues Markets. Brookings-Wharton Papers on Financial Services 5, 313-343.

Benveniste, Lawrence, Alexander Ljungqvist, William Wilhelm, and Xiaoyun Yu, 2003. Evidence of Information Spillovers in the Production of Investment Banking Services. Journal of Finance 58, 577-608.

Benveniste, Lawrence, and Paul Spindt, 1989. How Investment Bankers Determine the Offer Price and Allocation of New Issues. Journal of Financial Economics 24, 343-361.

Chemmanur, Thomas, and Mark Liu, 2003. 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.

Cornelli, Francesca, and David Goldreich, 2001. Bookbuilding and Strategic Allocation. Journal of Finance 56, 2337-2370.

Corwin, Shane A., Jeffrey H. Harris, and Marc L. Lipson, 2004. The Development of Secondary Market Liquidity for NYSE-Listed IPOs. Journal of Finance (forthcoming).

Derrien, Francois, and Kent Womack, 2003. Auctions vs. Book-Building and the Control of Underpricing in Hot IPO Markets. Review of Financial Studies 16, 31-61.

Habib Michael, and Alexander Ljungqvist, 2001. Underpricing and Entrepreneurial Wealth Losses: Theory and Evidence. Review of Financial Studies 14, 433-455.

Hasbrouck, Joel, 1993. Assessing the Quality of a Security Market: A New Approach to Transaction-Cost Measurement. Review of Financial Studies 6, 191-212.

Hsu, Yenshan, and Cheng-Yi Shiu, 2003. Public Information and Cascades in IPOs:

Evidence from Taiwan. Working paper, National Chengchi University, Taipei.
Kaneko, Takashi, and Richard Pettway, 2003. Auctions versus Book Building of Japanses IPOs. Pacific-Basin Finance Journal 11, 439-462.
Kuchinskas, Susan, 2004. Can Google Go Dutch? Internetnews.com, February 2, 2004. (www.internetnews.com/fina-news/article.php/3307451).
Levin, Dan, and James Smith, 1994. Equilibrium in Auctions with Entry. American Economic Review 84 (3), 585-599.
Ljungqvist, Alexander, Tim Jenkinson, and William Wilhelm, 2003. Global Integration in Primary Equity Markets: The Role of U.S. Banks and U.S. Investors. Review of Financial Studies 16, 63-99.
Ljungqvist, Alexander, and William Wilhelm, 2002. IPO Allocations: Discriminatory or Discretionary? Journal of Financial Economics 65, 167-201.
Loughran, Tim, and Jay R. Ritter, 2002. Why Don't Issuers Get Upset About Leaving Money on the Table in IPOs? Review of Financial Studies 15, 413-443.
Sherman, Ann, 2000. IPOs and Long-term Relationships: An advantage of bookbuilding. Review of Financial Studies 13, 697-714.
Sherman, Ann, 2003. Global Trends in IPO Methods: Bookbuilding vs. Auctions with Endogenous Entry. Working paper, University of Notre Dame.
White, H., 1980, "A Heteroscedaticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroscedaticity," *Econometirca* 48, 817-838.

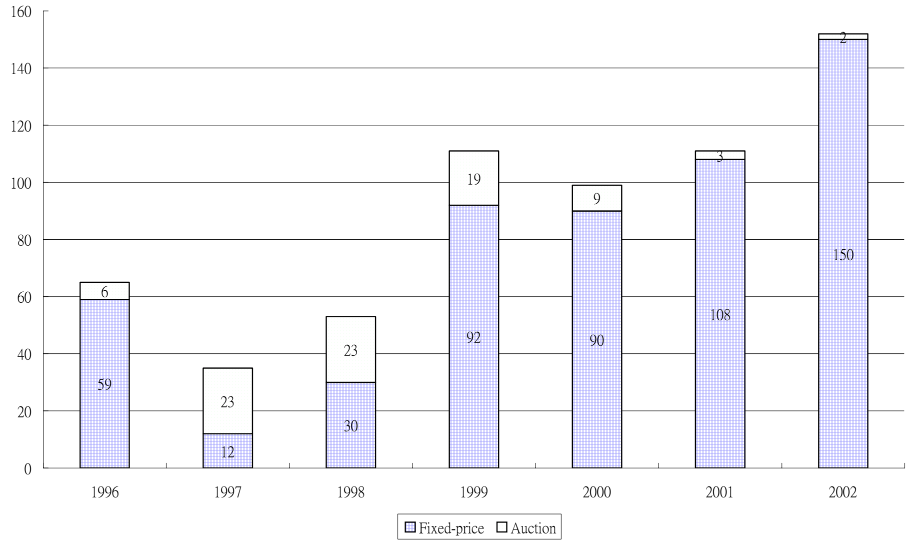

Figure 1

Frequency distribution of selling mechanisms by year: 1996 to 2002

Table 1

Summary statistics for 57 IPOs

Panel A. Descriptive Statistics of issue characteristics for 57 IPOs

		Fixed-price		Auction	
IPOs by IPO year	1998	9		13	
	1999	10		8	
	2000	13		4	
	Total	32		25	
		Mean	Median	Mean	Median
IPO Proceeds (NT$ millions)		700.93	449.16	4,929.42	1,057.19
IPO lots (thousands)		20.09	14.20	49.91	18.25
Fraction of equity sold		0.12	0.12	0.13	0.10
Issue price (NT$)		35.24	32.00	90.99	67.50
Sales (NT$ billions)		5.80	2.59	12.76	2.59
Assets (Book value) (NT$ billions)		37.44	4.60	23.74	2.94
Equity (Book value) (NT$ billions)		5.87	2.01	16.97	1.62
Ages (Years)		21.43	16.83	14.90	12.41

Table 1 (continued)

Panel B. Summary statistics of bid characteristics for 27 auctions.	Mean	Std. dev.	Median	Max.	Min.
Lots sold in Auction	19,816	56,347	9,125	289,431	1,833
Lots submitted by institutions	12,263	24,970	5,406	129,265	38
Lots submitted by individuals	20,313	15,628	15,620	79,387	4,359
Oversubscription by institutions	0.8288	0.5474	0.5959	1.8293	0.0068
Oversubscription by individuals	2.2102	1.1703	2.2690	4.8124	0.2743
Total oversubscription	3.0390	1.4770	3.3030	6.3754	0.7209
% of all shares sold to institutions	0.2823	0.2043	0.2726	0.8463	0.0000
% of all shares sold to retails	0.7177	0.2043	0.7274	1.0000	0.1537
Auction base price	63.46	47.12	50.00	250.00	20.00
Clearing price	104.87	86.60	97.21	452.00	26.20
WAP	107.38	87.43	101.88	457.01	27.17
NWAP	1.6634	0.3388	1.6006	2.5018	1.0000

The 57 sample companies went public and listed in Taiwan Stock Exchange (TSE) during the sample period from January 1998 to December 2000. Of these 57 IPOs, 32 firms used the pure fixed-price method and 25 firms used the auction method (sequential hybrid) to distribute their shares. Panel A reports descriptive statistics of issue characteristics for all IPOs. *Age* is the number of years from the year of inception of the firm to the IPO year. *Sales*, *assets*, and *equity* are based on financial statements of the year preceding the IPO. Panel B reports the summary statistics of bid characteristics for 27 auctions. *Oversubscription* is the total demand for shares divided by the total number of shares issued. *% of all shares sold to institutions (retails)* is the percentage of new shares that are sold to institutions (retails). *WAP* is the quantity-weighted average of all winning bids in an issue, while *NWAP* is the weighted average price of winning bids normalized by auction base price.

Table 2

Summary statistic of the 30-day aftermarket return volatility and efficiency

	Mean	Std. dev.	Median	Max.	Min.
Volatility measures					
Return std dev. (daily) (%)	3.0710	0.9840	3.0236	4.8866	0.9353
$P_H - P_L$ (daily)	2.9910	3.3809	1.4067	18.5000	0.3367
$(P_H - P_L)/P_M$ (daily)	0.0381	0.0104	0.0384	0.0588	0.0098
$P_H - P_L$ (15-minute)	0.6545	0.7091	0.2882	3.6211	0.0450
$(P_H - P_L)/P_M$ (15-minute)	0.0083	0.0022	0.0084	0.0127	0.0013
Efficiency measures					
$\lvert$Daily return AR1$\rvert$	0.1846	0.1242	0.1752	0.4943	0.0051
Standard deviation of noise	0.0023	0.0009	0.0023	0.0043	0.0006

This table represents the summary statistics of the 30-day aftermarket return volatility and efficiency for 57 IPOs in the sample period. P_H and P_L are respectively the highest and the lowest price during the measuring period, while P_M is the quantity-weighted average price. $\lvert$*Daily return AR*1$\rvert$ is the absolute value of the autocorrelation of the daily return. *Standard deviation of noise* is the pricing error using Hasbrouck's (1993) decomposition of tick-by-tick price.

.

Table 3

Influence of selling mechanism on aftermarket return volatility and efficiency: the second stage in 2SLS

Dependent variables	Volatility					Efficiency	
	Return std. dev. (daily)	$P_H - P_L$ (daily)	$(P_H - P_L)/P_M$ $(\times 100)$ (daily)	$P_H - P_L$ (15-minute)	$(P_H - P_L)/P_M$ $(\times 100)$ (15-minute)	$\lvert Daily\ return\ AR1 \rvert$	Std. Dev. of noise $(\times 1000)$
	Reg1	Reg2	Reg3	Reg4	Reg5	Reg6	Reg7
Constant	2.8134*** *0.8530*	-4.5044 *3.6253*	3.6659*** *0.8392*	-0.9843 *0.7072*	0.6262*** *0.2051*	0.3258** *0.1452*	3.8181*** *0.8008*
Predicted probability: Auction	0.9123** *0.4495*	6.3143*** *0.9487*	1.0151** *0.4260*	1.4144*** *0.2011*	0.2488** *0.0950*	0.0296 *0.0490*	0.6132* *0.3428*
Cap	-0.1286 *0.1019*	0.2932 *0.4788*	-0.2406*** *0.0890*	0.0704 *0.0916*	-0.0168 *0.0213*	-0.0159 *0.1507*	-0.3708*** *0.0807*
Market return std. dev	0.6037** *0.2697*					-0.0065 *0.0350*	0.9496*** *0.1983*
$Index_H - Index_L$		0.0150 *0.0111*		0.0028 *0.0021*			
$\frac{Index_{High} - Index_{Low}}{Index}$ $(\times 100)$			0.9601*** *0.2473*		0.1272** *0.0563*		
Adjusted R^2	9.40%	46.21%	21.27%	53.16%	13.09%	-3.29%	30.79%
N	57	57	57	57	57	57	57

This table reports the estimated coefficients (and White (1980) heteroscedasticity-consistent standard errors in italics under the coefficient estimates) of the second stage in the Probit Two-stage Least Squares, for testing the influence of selling mechanism on aftermarket return volatility and efficiency. The dependent variables include several volatility and efficiency measures. *Return std. dev.* is standard deviation of return. P_H ($Index_H$) and P_L ($Index_L$) are respectively the highest and the lowest price (index) during the measuring period, while P_M ($Index_M$) is the quantity-weighted average price (index). $\lvert Daily\ return\ AR1 \rvert$ is the absolute value of the first-order serial correlation of the daily return. *Standard deviation of noise* is the pricing error using Hasbrouck's (1993) decomposition of trading price. *Predicted probability: Auction* is the predicted probability calculated from the stage 1of the Probit 2SLS in the equation (2) in text, and is 1 if a firm would choose auction to sell IPO shares. *Cap* is the logarithm of the market value of equity (NT$1,000) for the IPO firm in the aftermarket. ***, **, and * indicate 1%, 5%, and 10% significance respectively.

Table 4

Analysis of aftermarket return volatility and efficiency for 25 auctions

Dependent variables	Return std. dev. (daily)	$(P_H - P_L)/P_M$ $(\times 100)$ (daily)	$(P_H - P_L)/P_M$ $(\times 100)$ (15-minute)	Std. Dev. of noise $(\times 1000)$
	Reg1	Reg2	Reg3	Reg4
Constant	0.4814 *0.8649*	0.4260 *0.8834*	0.2066 *0.3338*	1.3209 *0.7934*
Cap	-0.1802** *0.0746*	-0.1790** *0.0780*	0.0054 *0.0284*	-0.2916*** *0.0684*
NWAP	1.5532 *0.2472****	1.5164 *0.1905****	0.2765 *0.0671****	0.8194 *0.2419****
% of all shares sold to institutions	0.4418 *0.4724*	0.3549 *0.5950*	-0.1151 *0.1528*	-0.0255 *0.4458*
Market return std. dev	0.9817*** *0.3260*			1.3376*** *0.2566*
$\frac{Index_{High} - Index_{Low}}{Index} (\times 100)$		1.2837*** *0.3460*	0.0836 *0.0881*	
Adjusted R^2	38.93%	46.27%	20.70%	45.37%
N	25	25	25	25

This table reports the estimated coefficients (and White (1980) heteroscedasticity-consistent standard errors in italics under the coefficient estimates) of the analysis for aftermarket return volatility and efficiency for 25 auctions. *Return std. dev.* is standard deviation of return. P_H ($Index_H$) and P_L ($Index_L$) are respectively the highest and the lowest price (index) during the measuring period, while P_M ($Index_M$) is the quantity-weighted average price (index). *Standard deviation of noise* is the pricing error using Hasbrouck's (1993) decomposition of trading price. *Cap* is the logarithm of the market value of equity (NT$1,000) for the IPO firm in the aftermarket. *NWAP* is the weighted average price of winning bids normalized by auction base price. *% of all shares sold to institutions* is the percentage of new shares that are sold to institutions. ***, **, and * indicate 1%, 5%, and 10% significance respectively.

Table 5

The average bidding price by the demands of various investors: 25 auctions

Dependent Variable:	NWAP			
	Reg1	Reg2	Reg3	Reg4
Constant	0.8899***	1.5163***	0.9619***	0.9833***
	0.1485	*0.1415*	*0.1116*	*0.1067*
Ln_Oversub(all bids)	0.5824***			
	0.1182			
Ln_Oversub(institutional bids)		0.2617		-0.0979
		0.1941		*0.1788*
Ln_Oversub(retail's bids)			0.6382***	0.6689***
			0.1147	*0.1429*
Adjusted R^2	40.88%	0.95%	49.76%	48.12%
N	25	25	25	25

This table reports the estimated coefficients (and White (1980) heteroscedasticity-consistent standard errors in italics under the coefficient estimates) in the analysis results of aftermarket return volatility and efficiency for 25 auctions. The dependent variable is *NWAP*, which is the weighted average price of winning bids normalized by auction base price. *Ln_Oversub(all bids)* is the logarithm of the 1+total oversubscription with demand measured by total bids. *Ln_Oversub(institutioanll bids)* and *Ln_Oversub(retail's bids)* is the logarithm of the 1+total oversubscription with institutional demand and retail investors, respectively. ***, **, and * indicate 1%, 5%, and 10% significance respectively.