Public Information, IPO Price Formation, and Long-run Returns: Japanese Evidence

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The price formation process of JASDAQ IPOs is more transparent than in the US. The transparency facilitates analysis of important issues in the IPO literature--why offer prices only partially adjust to public information and adjust more fully to positive information, and why adjustments are related to initial returns. The evidence indicates that early price information conveys the underwriter's commitment to compensate investors for acquiring and/or disclosing information. Offer prices reflect pre-IPO market values of public companies and implicit agreements between underwriters and issuers that originate well before the offering. Under-adjustment of offer prices is substantially reversed in the aftermarket.

Keywords: IPO price formation; partial adjustment; underpricing; public information; long-run returns; over-allotment options

JEL classification: **G24; G32; G14, G28**

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The initial public offering ("IPO") underpricing puzzle has attracted the attention of scholars for more than three decades. Many hypotheses have been offered to explain why, on average, new issues are underpriced relative to the first aftermarket price; why, during the price formation process, offer prices do not adjust fully to new information about demand; and why, perhaps more surprisingly, offer price do not even adjust fully to public information. Despite numerous empirical studies, the US IPO evidence has not convincingly supported or refuted any of the hypotheses. However, the Japanese IPO market offers an opportunity for testing that can more effectively discriminate among them. The price formation process in Japan is more transparent than it is in the US and the constraining effects of public policy on IPO pricing are clearer.

In the US, initial public offering price formation begins with a "beauty contest" or "bake-off" where investment banks compete for the role of lead underwriter. The selected underwriter is responsible for conducting due diligence, organizing the syndicate, preparing the prospectus, and pre-selling the issue via a roadshow. Before the roadshow begins, the underwriter circulates a preliminary prospectus that generally includes a filing range. The filing range is the first public indication of the anticipated offer price. Just prior to the IPO, the underwriter sets the offer price. Typically, as shown by Hanley (1993) and others, the offer price is only partially adjusted in response to new information, so that the expected initial return is positive and positively related to the price adjustment.

Three streams of literature address underpricing and partial price adjustment of book-built IPOs. One stream, represented by Benveniste and Spindt (1989), Benveniste and Wilhelm (1990), Chemmanur (1993), Sherman (2000 and 2005), Sherman and Titman (2002), Chemmanur and Liu (2003), and Yung (2005), is focused on the relationship between the underwriter and investors. These studies develop and test hypotheses that underpricing, partial adjustment, and discriminatory allocations are used either to reward investors for disclosing information or to compensate them for acquiring information. A second stream, represented by Baron (1982), Loughran and Ritter (2002, 2004), and Lowry and Schwert (2004), is focused on the relationship between the underwriter and either managers or shareholders of the issuing firms. These studies develop and test hypotheses that underpricing and partial adjustment are due to bargaining power, agency costs, implicit contracting, or issuer

non-rationality. A third stream, represented by Booth and Smith (1986), Chemmanur and Fulgheri (1994), Purnanandam and Swaminathan (2004), Derrien (2005), and Edelen and Kadlec (2005), is focused on how offer prices relate to long-run or intrinsic value. These studies develop and test hypotheses concerning reputation, the opportunity cost of failed offerings, and pricing based on long-run value.

Institutional features of the Japanese IPO market afford a unique opportunity to disentangle the effects of the above complex and non-mutually exclusive determinants of underpricing and partial adjustment. We use a sample of Japanese IPOs from September 1997 through year end 2003 to study IPO offer price formation. We focus mainly on how public information that was known at various points in the process bears on price adjustments, underpricing, and long-run returns. In contrast to the US, the Japanese process includes an original price indication, an update after the roadshow to a filing range, and an update after the book is built to an offer price. In Japan, the filing range is not constrained by the original price, but the offer price is constrained by the filing range through "administrative guidance" of Japan's Ministry of Finance. The explicit filing-range constraints, combined with the lack of regulation on the width of the range, enable us to study the role of the filing range with more clarity than is possible for US IPOs. We also use these features to test how Japan's introduction of over-allotment and Green-Shoe options at the start of 2002 influenced IPO price formation.

We find that underpricing and partial adjustment of JASDAQ IPOs are affected by aspects of all three aforementioned relationships. Price rigidity with regard to the first price adjustment is best explained as resulting from an implicit contract between the issuer and the underwriter, which can reflect concerns with such factors as information acquisition, the opportunity cost of failed offerings, and long-run value.[1] The evidence of use of the filing range to constrain upward adjustments of the offer price is best explained as a commitment device that the underwriter can use to encourage investors to incur costs related to information acquisition. The filing-range constraints yield a pattern of asymmetric partial adjustment to good and bad news that is similar to the pattern observed in the US, but the pattern does not require an explanation based on prospect theory or selection bias due to withdrawn offerings. Sustained periods of very high initial returns appear to result from the combined

[1] The law and economics literature on implicit contracting and price inflexibility is extensive. Rosen (1985) reviews the early theoretical literature, with particular emphasis on implicit contracting and price rigidity in labor markets. The phenomenon of non-price rationing, and prices that do not adjust fully to information about demand is pervasive and widely recognized in many markets where one or more parties is a long-term participant.

effects of: early pricing discussions that can extend back for several months, the filing-range constraints, and the perception that the market is over-heated relative to long-run value.

I. Price Formation Literature and Hypotheses

Recent literature establishes that IPO offer prices in the US do not fully reflect even public information that is known at the time of the offering. Bradley and Jordan (2002) and Lowry and Schwert (2004) find that initial returns are explained partly by the initial returns of previous IPOs. Loughran and Ritter (2002), Lowry and Schwert (2004), and some earlier studies, find that initial returns are positively related to market-wide stock price increases before the IPO. This evidence of underpricing in response to public information is not an implication of the Benveniste and Spindt (1989) hypothesis that investors are being rewarded for disclosing private information they already possess. However, it can arise from costly information acquisition. Sherman and Titman (2002), for example, assume that the issuer and the underwriter care about pricing accuracy and select the number of investors and the extent of underpricing to encourage a desired amount of costly information acquisition. As explained in Sherman (2005), if investors' opportunity costs of information acquisition are correlated with market run-up, then public information can predict underpricing and partial adjustment from the filing range to the offer price. Building upon this stream of literature, Jenkinson, Morrison, and Wilhelm (2006) argue that when the maximum and minimum of the filing range constrain the offer price, the range can be used to encourage investors to acquire information or to disclose their private information.

Moreover, Lowry and Schwert find that even the midpoint of the filing range does not fully reflect public information. They question whether, at some earlier point, such as during the bake off, the underwriter and the issuer agree implicitly on the initial value, and to limit adjustments of the range or the offer price in response to subsequent market movements. If so, this could give rise to partial adjustment and, depending on the considerations that affect the negotiated offer price, to sustained episodes of unusually high initial returns. Such an implicit agreement is not independent of considerations related to information acquisition by investors or concern with the opportunity cost of a failed offering. The parties might, for example, agree not to raise the maximum of the range beyond a certain level to encourage investors to acquire information or to increase the likelihood of completing the IPO. However, it is hard to attribute the portion of the price adjustment that is

explainable by information from well before any publicly announced pricing to anything but the relationship between the issuer and the underwriter.[2]

The notion that price adjustments are limited by prior implicit agreements, combined with the occurrence of sustained episodes of substantial overpricing, begs the question of what considerations drive the terms of the agreement. In this paper, we consider four hypotheses: (1) information acquisition, (2) opportunity cost of failed offerings, (3) anchoring bias, and (4) pricing based on value relative to other publicly traded shares ("relative value").

According to Ritter (2003), early pricing discussions focus on offer prices that are implied by the market values of publicly traded shares of comparable firms. Purnanandam and Swaminathan (2004), and Derrien (2005), among others, find that offer prices reflect considerations of value relative to other publicly traded shares.[3] Using different approaches, Purnanandam and Swaminathan and Derrien find that share prices immediately after IPOs are too high compared to relative values, resulting in long-run underperformance. Pricing based on relative value is an implication of the certification role of the underwriter as hypothesized by Booth and Smith (1986) based on reputational capital, and Tinic (1988) based on exposure to litigation risk.

Consistency of offer prices with relative value can only hold on average. Compared to the first aftermarket price, some IPOs can be overpriced *ex ante*. If the over- or underpricing is importantly based on public information from before the offering, it should not be hard for investors to spot the IPOs that are likely to be overpriced and those that are likely to yield high initial returns. Benveniste and Spindt (1989) argue that average underpricing serves multiple functions, including using allocations of underpriced shares to compensate investors for occasionally buying shares that are overpriced. Sherman (2000), in a repeated setting, provides a

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[2] Conceivably, market run-up several months before the IPO could presage higher opportunity cost for investors to become informed about particular issues once the roadshow begins. This higher opportunity cost could be the reason for greater underpricing. We examined the relationship between IPO activity and prior JASDAQ run-up and found no support for the hypothesis that run-up two or three months before the IPO predicts IPO activity in the month ending on the IPO date. We also examined the relationship between initial returns and IPO activity in the month before the IPO and found a negative and significant relationship in a univariate regression, and negative but non-significant relationship when market run-up information is included. The empirical relationship could be negative because a high level of IPO activity reduces the effort an investor must expend before deciding to invest in a particular new issue. Moreover, the positive relationship of initial returns to prior market run-up could arise from higher opportunity costs associated with activities other than those we are able to measure. Thus, these empirical results do not preclude the possibility that run-up presages subsequent higher opportunity cost that is manifested in some other way.

[3] Purnanandam and Swaminathan refer to "fair value," which has specific legalistic meanings when used by the Securities and Exchange Commission, the Accounting Standards Board, and the Appraisal Institute. They assess relative value by comparing IPO firms to a matched sample of public firms. Derrien refers to "long-run intrinsic value," which implies value based on full information and an asset pricing model. He does not directly examine value relative to other firms, but relative value is implicit in the use of an industry returns index as a measure of expected returns. We follow Galev, Goetzmann, and Rouwenhorst (1999) in using the term, "relative value," to mean value based on comparison to other similar assets, without regard to the underlying asset pricing model or legal definition.

model where, in exchange for access to future shares in high demand offerings, uninformed investors accepting overpriced shares in low-demand offerings. Sherman demonstrates that by limiting access to only regular investors, the underwriter can require them to occasionally accept overpriced shares.

Loughran and Ritter (2002) note that any pattern of partial adjustment allocates risk between the issuer and the underwriter, and that investors who buy IPO shares also are parties to the allocation. Information-based theories can explain partial adjustment relative to private information even in an environment where no party is motivated by a desire to allocate risk. However, no hypothesis other than one based on an intentional allocation of risk and expected return seems able to account for partial adjustment in response to public information that arrives before any information about the offer price is released to the market.

Two of the remaining three hypotheses about partial adjustment reflect rational allocations of risk and expected return. Sherman (2005) hypothesizes that higher expected returns are necessary to compensate investors for acquiring information and that partial adjustment in response to public information can arise if the investors' opportunity costs of evaluating deals is greater in hot markets. Edelen and Kadlec (2005) hypothesize that partial adjustment can arise because deal failure is costly and asymmetric partial adjustment in response to good and bad news results from sample selection bias. Firms proceed with IPOs when confronted with positive initial market responses but, to better assure completion of the offering, do not adjust price fully, whereas those confronted with negative responses are more likely to withdraw the offerings. The third hypothesis, advanced by Loughran and Ritter (2002), is that issuers irrationally anchor on the filing range and are willing to under-adjust the offer price in response to positive information.

Complementary to evidence in studies by Bradley and Jordan (2002), Loughran and Ritter (2002), and Lowry and Schwert (2004), we find that underpricing of JASDAQ IPOs is greater following market run-ups that occur in months well before the IPO. Under-adjustment in response to public information extends throughout the price formation process. We find that the filing range is a biased predictor of the offer price and that the maximum of the range usually is a binding constraint on the offer price, so that it can function as a mechanism to encourage investors to engage in information acquisition.

Similar to the empirical findings of Purnanandam and Swaminathan (2004) and Derrien (2005), long-run returns of JASDAQ IPOs are lower when initial returns are high relative to public information available before

the offering. In fact, during the sample period of more than six years, mean under-adjustment relative to the initial return is more than offset by mean under-performance in the year after the IPO. Thus, the JASDAQ evidence connects the information acquisition hypothesis of Sherman and Titman (2002) to the argument that offer prices are based on relative value and that sustained periods of high initial returns can arise from episodes when IPO investors are overly optimistic relative to the market values of established, publicly traded firms.

As in the US, JASDAQ IPO price adjustments in response to public information are asymmetric. Offer price adjustments are stronger in response to negative information than to positive information. In our sample, the differential response is traced largely to the constraining effects of the filing range on price adjustments. This result, which cannot be studied as directly in the US because of differences in regulations and conventions with respect to setting and adjusting the filing range, supports the information acquisition hypothesis.

Most theories of underpricing and partial adjustment are not mutually exclusive and all arise from informal understandings between the issuer and the underwriter as to such things as how the offer price will adjust in response to new information, how the shares will be allocated, and so on. We do not, in this paper, propose any new theory of underpricing. Rather, we seek to understand how the various existing theories contribute to the underpricing phenomena that we observe. The informal understanding clearly can incorporate the established theories discussed above, but the Japanese evidence indicates that price adjustments also are affected by other aspects of the understanding. The evidence suggests that the underwriter will assume greater risk of an over-priced IPO if the issuer is willing to compensate them more, or to forego some of the upside, if demand is higher than expected. Such forbearance can lower the underwriter's marketing cost and enable the underwriter to compensate investors who occasionally are expected to buy over-priced IPOs.

Finally, we are able to examine the effects of the introduction of over-allotment and Green Shoe options on aspects of issue pricing. Consistent with the hypotheses of Benveniste, Busaba, and Wilhelm (1996) and Chowdhry and Nanda (1996), our evidence indicates that the options enable issuers to select significantly narrower filing ranges and to price the IPOs more fully, so that initial returns are lower.

II. The Japanese IPO Process

As shown in Figure 1, IPOs in Japan are described first in a Preliminary Prospectus. This prospectus includes an original price that is determined before the pre-marketing effort begins.[4] The filing range is introduced about ten market days later in a First Revised Prospectus that is circulated after the roadshow and before building of the order book. The offer price is announced about seven market days later in a Second Revised Prospectus. Aftermarket trading typically begins about eight market days after that. Japan is similar to the US (and different from Europe) in that the Preliminary Prospectus is issued before the roadshow begins, but is different from the US in that a First Revised Prospectus, including a filing range update of the original price, is always issued. Although the underwriter can begin seeking demand information earlier, informed investors formally do not need to indicate their interest until after this update, which initiates building the order book. Japan also is different in that the filing range in the update is binding on the offer price, whereas in the US amendments are possible until the day before the offer becomes effective.

A JASDAQ offer is effective the day after the Second Revised Prospectus is issued. At that point, the underwriter can deliver the prospectus to investors, who are then required to pay for any shares they wish to acquire. Unlike in the US, aftermarket trading does not begin until the entire issue (or as much of it as possible) is placed with investors.[5] The IPO date (i.e., day 0) is also the day when aftermarket trading begins. As in nearly all counties, including the US, the underwriter distinguishes between institutional and retail investors. A selected group of institutions are invited to participate in the roadshow. A larger group and some individuals are invited to submit indications of interest in the book-building process. For a typical JASDAQ offer, we are advised by industry sources that around 40 to 70 institutions and some key individuals submit indications of interest that are used in building the order book.[6]

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[4]According to industry sources, underwriters in Japan determine the original price by applying discounts to the values implied by the profit and assets value multiples of comparable firms. The practice is similar to the process that we found to be used by 15 underwriters in the US who participated in the beauty contest for a recent large IPO.

[5]Chowdhry and Sherman (1996a) indicate that, because of the potential for information leakages, underpricing must be greater when the offer price is set many days before the issue closes. In the case of Japan, an offsetting benefit is that the underwriter does not need to deal with flippers, who sell their allocations before the offering closes.

[6] Nomura reports around 30 institutions participate in a typical roadshow. Daiwa reports that 20 to 30 participate in a typical roadshow.

Retail investors are offered shares according to the policies of the investment bank.[7] Nomura determines the retail allocation before the roadshow and indicates that typically 20 to 30 percent of IPO shares are offered to institutions and that the allocation may be adjusted slightly depending on information from the roadshow. Daiwa indicates that factors that affect its retail allocation are (1) JASDAQ listing requirements that require at least 300 to 500 shareholders, depending on the firm's total shares outstanding, (2) concerns with fairness toward retail investors, and (3) limitations on some institutional investors that prevent their investing in small capitalization or recently listed firms. The percentage allocation to institutions normally is larger for larger IPOs.[8]

The JASD compiles aggregate statistics on allocations of IPO shares to individual investors. From 2002 through 2005, annual average allocations to individuals ranged from 76.4 percent (in 2002) to 81.7 (in 2003). The JASD statistics indicate that after the IPO, individuals are heavy net sellers to institutions.[9]

A. Filing Range

In the US, the role of the filing range in the IPO price formation process is unclear. By regulation and convention, overwhelmingly IPOs in the US are brought to market with filing ranges of two dollars.[10] By informal policy of the US Securities and Exchange Commission ("SEC"), the final offer price can deviate from the filing range by as much as about 20 percent below the minimum or above the maximum. However, because the SEC permits issuers to amend the filing range as little as one day before the issue is sold, the range that is first reported is not necessarily a good indicator of the final offer price.[11]

Although, in the US, the filing range does not establish binding constraints on the offer price, the partial adjustment evidence of Hanley (1993) suggests that it does have a limiting effect. In their study of filing range

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[7] Daiwa, for example, normally determines the retail allocation, distributes 80 percent of that to its branches, and sells the remaining 20 percent by lottery to retail investors.

[8] Interview with Daiwa SMBC IPO Department. Chowdhry and Sherman (1996b) acknowledge the fairness rationale that is offered by practitioners, but also provide a model where giving preference to retail investors can mitigate the (Rock, 1986) winners' curse problem and thereby reduce underpricing.

[9] Statistics are from the JASD website at http://www.jsda.or.jp/html/toukei/kojin/index.html.

[10] Item 501(b) (3) of Regulation S-K requires that the front page of the prospectus include "a bona fide estimate of the range of the maximum offering price and the maximum number of securities offered." The SEC has interpreted this to mean a maximum range of two dollars or 10 percent (revised to 20 percent in 2001) as a "safe harbor." However, under Rule 430A, pricing information may be omitted from a preliminary prospectus, as long as the fact of omission is disclosed and the underwriter undertakes to provide the information under provisions of the Rule. We thank the referee for providing details of SEC policy with regard to implementation.

[11] To document the US practice, we collected data on venture-backed IPOs from Thompson Financial. For 611 IPOs from October 1997 through October 2003, 93.9 percent had filing ranges of two dollars. In that sample, 8.4 percent were offered at prices that were more than 20 percent below the minimum implied by the original filing range and 23.9 percent were offered at more than 20 percent above the maximum. Bradley and Jordan (2002) examine the U.S. practice of amending the filing range. In their sample, 37 percent of issuers amended the filing range.

amendments, Bradley and Jordan (2002) provide evidence that upward revisions tend to occur in cases where the initial range would have resulted in extreme underpricing. Even after upward revisions, average underpricing still is much higher than for IPOs without revised ranges: an average initial return of 52 percent with revision, compared to an average of 18 percent without. Thus, underwriters/issuers in the US generally appear to regard the filing range as a commitment to investors about the eventual offer price, unless it becomes apparent that the issue would be extremely underpriced. In that case, the amended range and eventual offer price are set low enough so that investors generally do much better than in offers where the range is not revised.

The equity capital market of Japan offers a useful contrast. Unless the offering is cancelled on or before the final pricing meeting, the filing range in the First Revised Prospectus establishes binding maximum and minimum constraints on the offer price.[12] Unlike in the US, there is no common practice with regard to the size of the filing range of Japanese IPOs. Figure 2 shows time series data on filing ranges of JASDAQ IPOs from September 30, 1997 through the end of 2003. The figure includes both yen-valued ranges and natural logs of ranges. On October 1, 2001, a change in the Japanese Commercial Code led issuers to alter the typical IPO share price.[13] The effect of the change is apparent in Figure 2. Before the change, the most commonly selected range, 100 yen, was selected for only 16.8 percent of the IPOs. After the change, the most common range declined to 50 yen and was selected for 14.6 percent of the IPOs. Also, as shown in Figure 2, when the filing range is measured as the natural log of the maximum over the minimum, there is considerable variation of the selected ranges across IPOs, but the effect of the JASDAQ rule change is less apparent.[14]

Because the range constrains the offer price, it can be costly for an issuer to agree to a maximum price that it perceives to be too low. Conversely, because, unless the offering is cancelled, the underwriter is

[12] Kaneko and Pettway (2003) report that the practice of not setting the offer price outside the range is due to "administrative guidance" from the Ministry of Finance, which views the range as an implicit promise to investors. The parties can change the filing range by issuing an amended First Revised Prospectus, but such changes are rare. In our sample, only eight issuers of IPOs (1.6 percent) revised the range. All did so within six days of issuing the original First Revised Prospectus and all revisions were at least 11 days before the IPO and at least four days before issuing the Second Revised Prospectus. If the First Revised Prospectus is amended, our analysis is based on filing range data from the final First Revised Prospectus. We have incomplete direct information on cancelled offering but have been advised by industry practitioners that cancellation is rare. The claim by practitioners comports with indirect and our limited evidence presented later in this study.

[13] Before the end of 2001, some issues were offered at very high share prices, with number of shares comprising a trading unit determined, by law, as a function of the share price. After 2001, the number of shares comprising a trading unit was selected by the issuer. For descriptive purposes, we standardize all prices to trading units of 1000 shares. In the period before the end of 2001, we do this on the basis of stated value (i.e., similar to par value) per share. Kaneko and Pettway (2003) report mean share prices that are not standardized and therefore show much higher prices than we report in Table 1.

[14] While by this measure, the range is significantly lower after the end of 2001, the lower range appears to be associated with Japan's introduction of over-allotment and Green Shoe options, which occurred around the same time.

committed to purchase the offer from the firm, it can be costly to agree to a minimum that is too high. Because the choice of filing range is unconstrained, issuers and underwriters can avoid the potential for the range to limit the offer price by selecting a very broad range. However, a maximum that is too high may discourage investments in information. The function of the minimum is less clear. In the implicit contracting framework, it is easy to envision corporate capital needs that would lead a firm to negotiate a high minimum in exchange for accepting a lower maximum if demand proves to be high. But, there may be no reason that the privately agreed minimum needs to be the same as the publicly announced minimum of the range.[15] Such a private agreement cannot explain why the minimum of the range is regarded by Japan's Ministry of Finance as a constraint on the offer price. For that, one must look to the role of the minimum in providing information to investors. Clearly, investors can interpret the range as a statement from the underwriter to the effect that, "We think the issue is worth at least X (a reservation value below which we would rather cancel the IPO than sell). We think it is worth more, but will commit to a maximum price of Y to encourage investors to conduct their own investigations and disclose their conclusions."[16] To test whether issuers can negotiate for higher or tighter ranges, we also examine how the filing range is related to the fee charged by the underwriter, and whether the narrowness of the range is related to how fully an IPO is priced.

B. Over-allotment and Green Shoe Options

In contrast to the US, where over-allotment options and Green Shoe options are common, such options have been allowed in Japan only since February 2002. Over-allotment options enable the underwriter to reduce exposure to flipping by allotting more shares than are specified in the offer. The underwriter uses over-allotment options to hedge against a price decline after the IPO by taking a short position in the stock. Green Shoe options enable the underwriter to fill excess orders with additional shares rather than by repurchasing the shares in the market. In most cases, over-allotment and Green Shoe options are used in tandem so that the underwriter can fill orders either by covering a short position or by issuing additional shares. If the underwriter covers by

[15] In the implicit contracting literature, agreements are enforced by the cost of reputational harm rather than the potential for litigation. Tying provisions of the informal relationship to publicly observable parameters such as the filing range can enable firms with less well-established reputations to more credibly commit to an understanding and may lower enforcement costs. Conversely, the publicly stated minimum conceivably could be used to convey information about value to investors that is different than the reservation price that the issuer would use as a basis for deciding to withdraw an IPO.

[16] Jenkinson, et al. (2006) hypothesize in their study of European IPOs, that in cases where the range constrains the offer price, an underwriter and issuer can use information from informed investors and a subsequently determined binding narrow range to encourage selected investors to acquire and truthfully disclose information about the value of the issue.

repurchasing shares at below the offer price, its gain on shorting is offset by its cost, including reputational harm, of selling additional shares. If it covers the short by exercising the Green Shoe option, it gains the underwriting fees on the additional shares.

Benveniste, Busaba, and Wilhelm (1996) hypothesize that stabilization is a put option that substitutes for greater underpricing by rewarding investors for revealing private information. Chowdhry and Nanda (1996) hypothesize that stabilization reduces winners curse. Both imply that stabilization results in less underpricing. Aggarwal (2002) and Ellis, Michaely, and O'Hara (2000) find that cold issues are over-allocated and Ellis, et al. estimate that stabilization is not very costly to underwriters. Lewellen (2006) finds: (1) stabilization creates price rigidity below the offer price; (2) is not more prevalent when information asymmetries are high; and (3) is more commonly used by major underwriters. Fishe (2002) hypothesizes that underwriters choose offer price, and over-allotment options and aftermarket support levels to maximize their profits, including profits on aftermarket trading. Because our IPO sample spans the introduction of over-allotment and Green Shoe options, we can use this "natural experiment" to evaluate recent theories that options give rise to narrower filing ranges and more fully priced issues.

III. Data

Book building was introduced in Japan on September 1, 1997 as an alternative to its existing hybrid auction method. The first book-built IPO occurred on September 30.[17] From then through the end of 2003, 487 firms used Japan's book-building method to go public on the JASDAQ. Table 1 contains definitions and sample statistics for the main variables used in this analysis. The table also contains comparison statistics for the subsample of 357 IPOs before over-allotment and Green Shoe options were permitted (the pre-over-allotment period) and the subsample of 130 IPOs during the period when the options were permitted (the over-allotment period).

Throughout the analysis, all price adjustments, returns, and the filing range are measured in natural logs and all returns are buy-and-hold returns. Thus, we measure *Initial Price Adjustment* as the natural log of the buy-and-hold return from the original price to the midpoint of the range. *Offer Price Adjustment* (offer price/midpoint of the filing range), *Initial Return* (first after-market price/offer price), *One-year After Market Return* (the one-year

[17] Book building was quickly adopted in preference to the traditional hybrid auction method. The only subsequent auction-method IPO occurred on October 7, 1997.

later after-market price/first aftermarket price), and *Filing Range* (maximum of range/minimum of range) are measured in analogous ways, as are the JASDAQ return, various run-up values, and *Underwriter Fee*.[18]

In their examination of European IPOs, Jenkinson, et al. (2006) find that the midpoint of the range is a negatively biased predictor of the offer price. The result in Table 1 is similar. Mean *Offer Price Adjustment* of 0.051 is significantly positive (t-value = 14.3). However, the mean *Offer Price Adjustment* is partly offset by the -0.021 mean *Initial Price Adjustment*, which is significantly negative (t-value = -2.6). The standard deviation statistics in the table indicate substantial cross-sectional variation in both *Initial Price Adjustment* and *Offer Price Adjustment*.

Based on tests of differences in means and on Wilcoxon rank sum tests, firms during the over-allotment period were younger (a mean of 22.4 years compared to 25.1) and offer sizes were smaller than during the pre-over-allotment period (a mean of 1.62 billion yen without option exercise compared to 2.95 billion). Initial price adjustments are more negative and filing ranges are narrower during the over-allotment option period. Long-run (one-year) after-market returns are negative in the pre-over-allotment period, corresponding to lower long-run changes in the JASDAQ Index. Underwriter fees are higher during the over-allotment period and underwriter market share is lower.

Anticipating our empirical analysis, the mean value of *Total Return* in our sample is 0.205, comprising an *Initial Return* of 0.255 and a *One-year Aftermarket Return* of -0.050. During the same period, the mean *One-year JASDAQ Return* was 0.294. So, on net, the mean positive *Total Price Adjustment* of 0.030 and the JASDAQ-adjusted total return of -0.089 transferred wealth from investors to issuers. This result, however, is sensitive to outliers. The median *Total Price Adjustment* of 0.018, combined with the median *Total Return* of 0.117, less the median *One-year JASDAQ Return* of -0.096, implies a median net transfer to investors of 0.195, which is close to the 15 percent target relative-value discount that commonly is referred to by practitioners.

In Table 2, we focus on the subsample of IPOs from the over-allotment period. Forty-three of the 130 IPOs during this period included over-allotment and Green Shoe options. Consistent with the expectation that these options reduce issue price uncertainty, IPOs with options have less-negative initial price adjustments,

[18] All JASDAQ IPOs through 1998 and most of them afterwards were traded in the aftermarket by Dutch auction at the same price for all shares traded on any given day. After 1998, there has been a gradual trend toward continuous trading using a market-maker system similar to that of the US over-the-counter market.

narrower filings ranges, and lower initial returns. Inclusion of options is more common after run-ups in the JASDAQ index and for larger IPOs underwritten by high-market-share underwriters. The latter result supports Lewellen (2006), who studies US IPOs and finds that stabilization activities are more common for IPOs underwritten by larger underwriters. Although not shown in the table, short-coverage is more likely to occur when *Initial Return* is low (mean = -0.0095), whereas Green Shoe options are more likely to be exercised when *Initial Return* is high (mean = 0.2011).

A simple Probit model of use of over-allotment options shows their use to be significantly and positively related to calendar year, underwriter market share (major underwriter versus all others), and issue size. Over the two years covered by the sample, 33.1 percent of issues include over-allotment options, 16.2 percent of the 2002 IPOs and 51.6 percent of the 2003 IPOs. The top three underwriters (Nomura, Nikko, and Daiwa) used over-allotment options for 51.4 percent of their IPOs, 31.4 percent of the 2002 IPOs and 70.3 percent of the 2003 IPOs. The mean size of issues with over-allotment options is 1.98 billion yen, compared to 1.44 billion without.[19]

In subsequent empirical analysis, we estimated models pooling all of the data and separate models for the pre-over-allotment period and the over-allotment period. Results for the pre-over-allotment period were similar to those based on the entire sample. Results based on the over-allotment period also were similar, but were less stable due to the smaller number of observations. Accordingly, in the empirical analysis, we report the results for the full sample and use binary variables to measure the effects of including over-allotment and Green Shoe options.

IV. Price Formation in the IPO Sample

Table 3 provides information on the distribution of *Initial Price Adjustment*, *Offer Price Adjustment*, and *Initial Return*. While the mean initial price adjustment is near zero, there is considerable variation. As shown, 15.6 percent of the initial adjustments are positive enough so that the minimum of the filing range is above the

[19] The pattern of diffusion of use appears to be typical of innovations. Only 8.8 percent of the issues in the first six months of 2002 included over-allotment options, and all three of those issues were by the same underwriter. During the rest of 2002, use spread to the other two major underwriters, and during 2003 over-allotment options began to be used by other underwriters. In 2004, the percentage of issues with over-allotment options was approximately the same as in 2003, 47.9 percent. The three major underwriters continued to underwrite IPOs with and without over-allotment options.

original price, and 20.7 percent are negative enough so that the maximum is below the original price. Thus, the original price does not prevent selecting filing ranges that are strictly either higher or lower.

In subsequent analysis, we find that initial price adjustments are partly explained by information that could have been ascertained before the original price was set. As a result, the original price for any given IPO is a biased predictor of the range. However, much of the variance of *Initial Price Adjustment* is unexplained by such factors or by public information about the overall market that arrives after the original price is set. Thus, other information appears to affect the initial price adjustment. This could include public information for which we have not specifically accounted (such as the market performance of other specific firms), new developments for the company or its rivals, information derived through due diligence, and information received from roadshow participants. Evidence related to the subsequent price adjustment (from filing range to offer price) suggests that the roadshow contributes importantly to the initial adjustment.

From Table 1, the mean of *Offer Price Adjustment* (from the midpoint of the range) is significantly positive. However, Table 3 shows that the adjustment is constrained by both the maximum and the minimum of the range. Over two-thirds of the IPOs are offered at the maximum and another 8.6 percent are offered at the minimum. Not shown in the table, IPOs offered at the maximum are significantly more likely to be followed by positive initial returns and those offered at the minimum are significantly more likely to be followed by negative initial returns. Of the IPOs offered at the minimum, 43 percent have negative or zero initial returns and the mean is negative 2.0 percent. Thus, if investors were able to participate selectively in IPOs, they could avoid negative expected initial returns by not participating in IPOs priced at the minimum.

While the mean initial return in the IPO sample is over 25 percent, initial returns are negative for over 15 percent of the IPOs. Only five of the 74 IPOs with negative initial returns included over-allotment options, which would enable the underwriter to mitigate losses by implicitly shorting the offering. For the others, the underwriter might bear the initial losses directly, or might bear reputational costs with investors. Benveniste and Spindt (1989), Sherman and Titman (2002) and others suggest that underwriters shift the direct costs to investors by using allocations of underpriced shares partly to compensate investors for participating in offerings that are predictably overpriced.

The correlation statistics in Table 3 indicate that partial adjustment occurs both from the filing range to the offer price (as in the US) and from the original price to the filing range. Thus, in Japan, a price that is introduced before the roadshow still appears to restrain price adjustments. This is true even though in Japan there is a second adjustment that occurs before the book on the offering is built.

The evidence that both the maximum and the minimum of the range often are binding has more than one potential explanation. If all that is needed to induce information acquisition and disclosure is a commitment to a low maximum, why not then set the minimum low enough so that predictable over-pricing does not occur? Jenkinson, et al. (2006) offer one explanation. Building on Benveniste and Spindt (1989) and Sherman and Titman (2002), they argue that a commitment to adhere to a yet-to-be-specified range encourages investors to engage in information acquisition and to reveal their information early. For European IPOs, information collection occurs before any price is announced publicly and the underwriter is assumed to base the filing range on information from informed investors. Jenkinson, et al. model pricing within a narrow range as an element of a commitment device that the underwriter uses to induce truthful revelation. In their model the minimum must be high enough to punish providers of untruthful negative information. As supporting evidence, they note that European IPOs rarely are offered at above the maximum. The specifics of their model depend on the potential for uninformed investors to become informed and to crowd-out informed investors when issues are substantially over-subscribed. These specifics do comport with standard practice in Japan. Based on discussions with underwriters, the allocation to institutions is set in advance, normally at 20 to 30 percent of the offering, and is modified only slightly based on indications of interest.

Other formal theories of underpricing such as those of Benveniste and Spindt (1989) and Titman and Sherman (2002) focus on partial adjustment relative to the midpoint of the range, without attention to the width of the range. This is understandable in the US, where the width of the range is strongly affected by regulation and SEC practice, and because pricing outside the range and late amendments are permitted. For US IPOs the range is announced before the roadshow. Indications of interest come after and can precipitate an amendment of the range. The key differences in Japan are that the roadshow precedes setting the range, the offer price is constrained by the range, and revisions of the range are almost non-existent. In both countries, the actual building of the book occurs after the range is set. In Japan, it is clear that the upper limit of the range can

function as a commitment device that encourages selected investors to become informed. The lower limit or the width of the range also may convey information about such things as the issuer's reservation value, the understanding between the issuer and the underwriter, the assessments of value that the underwriter has received from other investors, and so on. Because it appears that a formal model could be developed around any one of these differences, we interpret our evidence in light of them all.

V. Empirical Analysis

To test the effects of prior market-wide changes, the filing range, and over-allotment options on IPO price formation, we estimate a recursive system that includes simultaneous and censored regression models. To test whether price adjustments also are affected by concerns that demand for the IPO may reflect investor over-optimism, we examine the relationships between price adjustments and long-run returns over the 12-months after the IPO. All results are reported in Table 4. Because the data for the observations are from overlapping periods, statistical significance levels can be overstated by ordinary least squares (OLS) regression. To address this, in the OLS models we report clustered robust standard errors where the clusters are calendar quarters. Significance levels based on clustered robust standard errors are not materially different from the standard errors that are generated without clustering or heteroskedasticity correction.

A. Initial Price Adjustment and Filing Range

By setting the filing range in the First Revised Prospectus, the underwriter simultaneously determines the initial price adjustment. In Panel (a) of Table 4 we report three-stage-least-squares (3SLS) and OLS estimates of models of *Initial Price Adjustment* and *Filing Range*. In the 3SLS model, *Initial Price Adjustment* and *Filing Range* are determined simultaneously. In the OLS models, we include the same explanatory variables as in the 3SLS models. Most of the variables in the *Initial Price Adjustment* equation (i.e., market run-up variables, *Offer Size*, *Underwriter Fee*, and the over-allotment variables) would have been known to investors when the Preliminary Prospectus was issued. *Underwriter Market Share* is based on IPOs during the sample period. Because the market shares during the sample period are similar to those in earlier periods, we interpret market share as if it were known.

In the *Filing Range* equation, we add variables that are intended to reflect uncertainty about the value of the offer and use a combined measure of market run-up over the eighty days ending on market day -20. The

number of IPOs in the prior four months is an indicator of the extent of information the underwriter and investors would have had about market conditions before the IPO. *Standard Deviation of JASDAQ-Adjusted Returns* is measured over the 12 months after the IPO, and is not observable at the time the range is set. We assume that this *ex post* measure of non-market risk is correlated with the *ex ante* estimate of non-market risk the underwriter would have had. We focus discussion on the 3SLS results because, except for the coefficients on the endogenous variables, the simultaneous and OLS results in Panel (a) of Table 4 are similar to the 3SLS results.

A.1. Initial Price Adjustment

In the *Initial Price Adjustment* model, the adjustment is negatively related to *Filing Range*. Figure 3, which we discuss more fully below, shows graphically that the sign of this relationship arises partly from resistance to setting the maximum of the range below the original price. The coefficients on the four 20-market-day intervals of market run-up ending 20 market days before the IPO all are positive, less than one, and decreasing in magnitude as time before the IPO increases. Because all but the last few days of this information normally is known when the Preliminary Prospectus is published, it is apparent that the original price does not fully reflect public information. [20]

Whereas Lowry and Schwert conclude that the market is "almost efficient" with respect to prior public information, our result, even at this early stage, is closer to that of Bradley and Jordan (2002), who find that about 35 percent of the variance in initial returns is explained by prior public information. Along similar lines, we find that stickiness in setting the original price is of a magnitude that is economically important in the sense that the original price does not efficiently reflect prior public information. In the simultaneous equations estimate, the standard deviation of *Initial Price Adjustment* due to prior changes in the JASDAQ Index is 7.6 percent, or 18.8 percent of the variance of *Initial Price Adjustment*.

There are several explanations for the finding that the initial price adjustment depends on public information from well before the IPO. First, as proposed by Lowry and Schwert (2004), discussions between the underwriter and the issuer in the months before the IPO may contribute to stickiness of the original price. This could result from some undisclosed tradeoff that is understood and implicitly agreed to by the underwriter and

[20] We also tried including the standard deviation of aftermarket returns in all models in Table 4, and selectively tried including firm age and number of IPOs in the prior 30 calendar days as indicators of value uncertainty. None of the coefficients or significance levels reported in Table 4 changed materially. Accordingly, we report the more parsimonious models. Supplemental results referred to in the footnotes are available from the authors on request.

the issuer. Second, as argued by Loughran and Ritter (2002), it could reflect an irrational (i.e., prospect-theory based) anchoring bias of the issuer. Third, as proposed by Edelen and Kadlec (2005), it could reflect the issuer's willingness to underprice more in the face of good news to increase the likelihood of the IPO being completed. Fourth, as hypothesized by Sherman (2005), if the opportunity cost of investors becoming informed increases after periods of market run-up, it could indicate that issuers must provide additional compensation to investors for evaluating IPOs after periods of market run-up. A variant of the opportunity cost explanation is that setting the original price may not be worth much effort, especially if it is non-binding, which it may be because it is subject to two revision opportunities. If little effort goes into setting the original price, then we could find the observed pattern of partial adjustment with respect to the initial adjustment. Our evidence, however, does not support this variant as the evidence demonstrates that the original price affects the filing range and the initial adjustment often results in filing range constraints that are binding on the offer price.

Only the fourth of these hypotheses can be more fully examined at this point. Investors' opportunity costs of evaluating IPOs could increase after market run-ups if the number of IPOs they can participate in increases after market run-ups. If so, then prior market run-up might be expected to predict the level of subsequent IPO activity. We tested this by regressing the number of JASDAQ IPOs in the 30 calendar days ending on the IPO date on the four 20-market-day JASDAQ run-up variables in Panel (a) of Table 4. With standard errors clustered by quarter, none of the run-up variables was statistically significant at even a low level. We also tested whether run-up in the month of the IPO is predictable based on run-up in the prior months, but found no significant relationship. Even if investor opportunity costs do increase with increases in the JASDAQ, there is no evidence that run-up in one month foreshadows run-up in subsequent months. Finally, we tested whether underpricing depends on prior IPO activity, as might be implied by the opportunity cost argument. The relationship of initial returns to IPO activity over the prior 30 days is consistently negative, and is statistically significant when market run-up variables are not included as regressors.

Although we find no statistical evidence that investors' opportunity costs increase after run-ups, we have only looked at two indicators of opportunity cost and we effectively have assumed that investor resources available for IPO evaluation are fixed. Our tests also ignore the possibility of cross-IPO information economies, such that high IPO activity could lower the cost of information acquisition for any given IPO. A more

comprehensive model of investor opportunity cost might yield different results, but is beyond the ability of our data to test. Further, the opportunity cost argument is not limited to the cost of investors becoming informed. Rising JASDAQ prices may, for example, also raise the opportunity cost of underwriters, leading them to spend less effort on roadshows and book building or on due diligence.

In the Panel (a) models, *Initial Price Adjustment* is positively related to *Underwriter Fee*. Given that the mean adjustment is negative 2.1 percent and the standard deviation of the marginal effect of the fee is 1.2 percent, the coefficient on *Underwriter Fee* suggests that higher fees are associated with greater resistance to reducing the filing range relative to the price reported in the Preliminary Prospectus. We also considered the possibility that both the higher fees and resistance to downward initial price adjustments are associated with more accurate pricing of the IPO. We found a marginally significant (at the one-tailed 0.10 level) negative cross-sectional relationship between the fee and the absolute deviation from the mean of the JASDAQ-adjusted 12-month aftermarket return including the initial return. Thus, conceivably, the higher fees result in more accurate pricing of the IPO relative to long-run value.

Initial Price Adjustment also is significantly more negative during the over-allotment period. During much of the over-allotment period, changes in the JASDAQ Index would have implied positive initial price adjustments, whereas the actual adjustments tended to be negative. The evidence suggests that over-allotment and Green Shoe options may cause issuers to be less concerned about increasing the offer price in response to positive market-wide information, preferring instead to issue more shares.

Although we explain 28 percent of the variance in *Initial Price Adjustment* with information that would have been available to investors at the time, we cannot explain the remaining 72 percent. This, combined with the 17.4 percent standard deviation of *Initial Price Adjustment*, suggests that the original price alone provides little incentive to investors to acquire or disclose information during the period before the filing range is established and that any such incentive is apt to arise through an investor's repeated experience with the ultimate pricing by the underwriter.

On the other hand, the evidence that prices do not adjust fully, even in response to negative market-wide information supports the concept of an implicit understanding between the issuer and the underwriter. The key issue at this point is why market-wide returns from well before the IPO have any bearing on the initial price

adjustment. If they were fully reflected in the original price and in the midpoint of the range, or if they were not reflected at all, or only partially reflected to a consistent degree, then the coefficients on market run-up three and four months before the IPO should be zero. The fact that the coefficients on these variables are positive and significant could arise from any scenario where the price adjustment is gradual, including scenarios where the midpoint of the range is fully adjusted and scenarios where it is not. If, by the time the offer price is set, the adjustment to old market-wide information is full, then we might infer that the original price-setting exercise had no bearing on the final offer price. However, we find below, in our examination of initial returns that the offer price is not fully adjusted, and we infer from this that the early price discussions do have a restraining effect on the eventual offer price.

A.2. Filing Range

In the filing range model, we allow for different effects of positive and negative initial price adjustments by including *Absolute Value of Initial Price Adjustment*.[21] The combined effect of the two variables is similar for the simultaneous and OLS models. Positive price adjustments are associated with narrower filing ranges than are negative adjustments. When a negative initial price adjustment is made, the underwriter also selects a wider filing range. Figure 3 shows maximum and minimum initial price adjustment in natural logs, as well as the natural log of the range. Data in the figure are arrayed by the initial price adjustment from the offer price to the midpoint of the range. IPOs toward the left of the figure have the most negative initial price adjustments. As indicated by the regression models in Table 4, they also tend to have the widest ranges.[22] The figure also shows evidence of resistance to setting filing ranges that do not bracket the original offer price. Resistance to setting the maximum above the original price indicates that underwriters may regard the original price as a commitment to investors unless subsequent evidence suggests that the issue would be substantially underpriced. The figure also shows evidence of resistance to setting the maximum below the offer price. Resistance to lowering the maximum relative to the original price does not appear to be consistent with motivating investors to engage in information acquisition. It seems more plausible that this resistance relates to the implicit contracting explanation that the

[21] In OLS and censored regression models, including the absolute value of a variable has an equivalent effect to interacting the variable with one when the price adjustment is positive, and zero otherwise, which, because the results are easier to interpret, is the approach we use elsewhere in Table 4. However, in the simultaneous equations estimates, the interaction approach produces unstable results.

[22] We considered the possibility that downward initial price adjustments are associated with periods of greater market-wide uncertainty. However, when we compared initial price adjustments to JASDAQ changes over the 80 market days ending 20 days before the IPO, we found a weak indication that higher pre-offering variability of JASDAQ run-up is associated with initial price adjustments that are more positive.

underwriter will not set a lower price unless subsequent information is very negative. A similar pattern of resistance is apparent with regard to the minimum of the range relative to the original price. Resistance to raising the minimum above the original price could be related to compensating investors for acquiring information or could be part of an understanding between the underwriter and the issuer. Of course, these explanations are not mutually exclusive.

To gain a fuller understanding, we undertook similar analyses for issues underwritten by each major underwriter and by the group of non-majors. The only difference of note is that even though the majors tended to set somewhat narrower ranges, they also are more likely than non-majors to set the filing range to bracket the original price. In addition, they were much more likely to set either the maximum of minimum of the range to equal the original price. They did so 30.9 percent of the time, compared to 22.1 percent of the time for non-majors. It appears that the majors are able to price more accurately and are more committed to setting a range that brackets the original price.

In the more detailed examination of the 253 IPOs with downward initial price adjustments, Table 3 shows that 93 (36.8 percent of those with negative adjustments) lowered the range to a point where the maximum was equal to the original price. The 101 that set the maximum below the original price tended to set it much lower. The most positive (non-log) discount of the maximum relative to the original price for this group is 5.39 percent and the average is a maximum that is discounted 24.1 percent relative to the original price.

In Table 4, run-up over the 80-market-days ending 20 days before the IPO is negatively related to *Filing Range*. When faced with negative market-wide changes before the IPO, underwriters appear to select wider (and lower) filing ranges.

Risk allocation argues for a broader range when value is most uncertain. *Firm Age*, *Offer Size*, and amount of IPO activity prior to the offering (*Number of IPOs in Prior Three Months*) are factors that should contribute to greater confidence in the offer price. As presented in Panel (a) of Table 4, all of these variables are associated with a narrower filing range. A higher underwriter fee also is associated with a narrower range. The higher fee could be a reward for bearing additional risk of overpricing or compensation for more effort to determine the offer price through more intensive due diligence and/or a more extensive roadshow. Value uncertainty, as reflected by *Standard Deviation of Abnormal Returns,* also is associated with a wider range. The

availability of over-allotment and Green Shoe options reduces price uncertainty and underwriting risk. As expected, availability of these options is associated with a narrower range.

B. Offer Price Adjustment

In Panel (b) of Table 4, we compare the results of estimating the Offer Price Adjustment model by censored maximum likelihood regression and OLS.[23] As shown in Table 3, *Offer Price Adjustment* is censored from above or below for 76.4 percent of the observations. Focusing on the censored regression results, we find no significant relationship between *Offer Price Adjustment* and *Initial Price Adjustment*. In the spirit of Loughran and Ritter (2002) and Lowry and Schwert (2004), we allow for differential effects of positive and negative initial price adjustments by including the interaction of *Initial Price Adjustment* with a binary variable that equals one if the adjustment is positive. Although the variable, *Positive Values of Original Price Adjustment*, is not significantly related to *Offer Price Adjustment*, other information that is public at the time the offer price is set clearly does matter. Because price adjustments relative to the filing range midpoint predominantly are positive, adjustments tend to be larger the larger is the range. Although Loughran and Ritter and Lowry and Schwert examine the adjustment from filing range to offer price, they both focus on the midpoint and do not test whether the range affects the size of the adjustment. Given the widespread US practice of setting the range at $2, this is not surprising. However, if in the US, the range, together with SEC "safe harbors" on price adjustments limits the offer price adjustments similarly to the way that it does in Japan (but with less precision and without direct observability), then the US range may also function as a commitment device.

Following Lowry and Schwert (2004), we also allow for differential effects of positive and negative market run-ups over the 20 days before the offer.[24] Within the range, based on the censored results, the coefficients of 0.89 on *Run-up -20 to 0* and -0.84 on *Positive Values of Run-up -20 to 0* indicates that the offer price adjusts almost fully in response to negative changes in the JASDAQ Index over the interval, but essentially not at all in response to positive changes. The data description in Table 3 provides the explanation for this result. It

[23] We also tried estimating these models by combining the initial price adjustment and the offer price adjustment into a single total adjustment. The results were not qualitatively different than can be obtained by summing the coefficients for the two sequential adjustments. The t-statistics also are intuitive based on those reported in Panels (a) and (b) of Table 4.

[24] Although the offer price is set several days before day 0, we were concerned that measuring market run-up over a period ending earlier could bias the coefficient estimate if some IPOs are priced later than any particular last date we selected. To produce an unbiased estimate, we use the period day -20 through day 0. Our assumption is that returns that the portion of the returns distribution that was not observable at the time of pricing would be random with a mean of approximately zero and uncorrelated with the rest of the run-up or with the dependent variable.

shows that filing range midpoints are negatively biased relative to the offer price, enough so that over two-thirds of the IPOs in the sample are issued at the maximum of the range. With the constraint being binding on so many IPOs, there is essentially no way for offer price adjustments to reflect positive market-wide news once the range is set. In some cases, inability to adjust the range upward based on run-up in the days before the offer was priced would result in what Loughran and Ritter (2002) refer to as leaving considerable money on the table. [25]

Within the filing range, adjustments in response to JASDAQ changes over the 20-market-day intervals ending 20, 40, and 60 market days before the IPO also are high. We tested for asymmetric price responses to positive and negative JASDAQ changes over these intervals and found no significant effects. Accordingly, we report only the symmetric estimates. As was true of the original price, the filing range does not fully reflect public information about prior market returns. Our results are similar to the findings of Lowry and Schwert (2004), except that again the effects are economically significant, particularly based on the coefficients from the censored regression, where the estimation biases due to censoring are removed. In the censored regression, the standard deviation of the effects of all market run-up variables on *Offer Price Adjustment* is 14.2 percent. In the OLS regression, the standard deviation of the run-up effects is a much smaller 3.3 percent. The latter figure is similar to the OLS result that Lowry and Schwert obtain for US data and upon which they base the inference that the pricing process is "almost efficient". The Japanese result suggests that unobserved censoring bias also may affect the US results.

Underwriter Market Share is negatively related to *Offer Price Adjustment*. This appears to be an artifact of the combined effects of high-market share underwriters setting narrower ranges and most IPOs being issued at the maximum of the range. Similarly, consistent with the earlier results, that *Filing Range* is narrower when *Underwriter Fee* is high, a higher fee is associated with lower *Offer Price Adjustment*. We find no significant relationship of *Offer Price Adjustment* to the availability or use of over-allotment options, though both coefficients are negative.

Because of censoring, OLS produces coefficients that are biased toward zero. Results in Panel (b) confirm this. Most of the coefficients in the OLS model are lower than in the censored model, though the t-values are similar. The most obvious differences relate to previously discussed responses of *Offer Price Adjustment*

[25] Particularly during 1999, a number of IPOs had log-normal values of *Run-up -20 to 0* in excess of 20 percent. The constraining effect of the maximum of the range is even more severe in 2004 and 2005, the first two years after our sample period. During these two years, almost all JASDAQ IPOs were issued at the maximum of the filing range. This occurrence in the post-sample period is consistent with our analysis, as during 2004 and 2005 the JASDAQ Index increased fairly steadily at a rate that doubled its value over the two years.

to changes in the JASDAQ Index. Based on the OLS results, as in the US, offer prices adjust only partially to changes in public information. However, the censored regression results demonstrate that within the bounds of the filing range, the adjustment is approximately full.

Figure 4 shows the difference between the predicted adjustments based on the OLS and those based on the censored model. In it, we plot the actual and OLS predicted values of the offer price adjustment. We also compare the OLS predictions to those from the censored model. While the OLS predictions track the actual price adjustments, predictions from the censored model show expected adjustments as if the filing range were not a constraint. In the figure, we also plot *Initial Return*. The initial returns are large compared to *Offer Price Adjustment*. However, if, but for the filing range constraint, the adjustment to public information is full, then the predictions from the censored regression should approximately track *Initial Return.* Figure 4 confirms this expectation. Particularly for the period of about one year, from early 1999 though early 2000, removal of the filing range constraints, holding all else constant, would have generated IPO prices that were more than 50 percent higher than the selected offer prices and still would have resulted in initial returns that were predominantly positive. Of course, removal of the filing range constraints is a hypothetical exercise, and actual removal would likely have some other effects. Thus, we interpret the difference between the censored and OLS results as a measure of the additional initial return that investors could expect that is due to the constraints. The Figure 4 comparison of the censored regression prediction with the initial returns indicates that much of the initial return can be predicted on the basis of information available to investors at the time when the IPO price is determined.

This result may have implications for interpreting partial adjustment of US IPOs, where the absence of specific, rigorously enforced constraints and the ability to amend the filing range cloud the analysis. Our evidence shows that the sustained period of extreme underpricing, as well as shorter episodes, were highly predictable based on public information from up to four months before the IPO, which approximately spans the period over which most IPO negotiations are reported to be conducted.[26]

The often-binding maximum constraint of the filing range distinguishes between hypotheses based on information acquisition and other hypotheses based on issuer irrationality, opportunity cost of failed offerings, or

[26] We also tested whether the price adjustment was affected by JASDAQ run-up over the -100 to -80 window. The coefficient was not significantly different from zero and was dropped from the analysis.

implicit contracting regarding minimum price. None of the latter hypotheses appears to offer a compelling rationale for publicly committing to a maximum price that is likely to be binding and costly for the issuer in a counter-factual environment where investors are assumed not to engage in information acquisition or disclosure. The upper bound in Japanese IPOs appears to serve, *a fortiori*, as a demonstration of commitment to compensate investors. As the range is discretionary, there is little reason for issuers and underwriters to formalize and publicize their private understandings based on rational incentive contracting and there is no reason to do so based on prospect theory, or the opportunity cost of a failed offering.

That said, the patterns of resistance in Figure 3 suggest that some of these other explanations do affect the range. The resistance to setting the maximum above the original price may indicate that the underwriter regards the offer price as a public commitment not to set a higher offer price unless doing so would lead to substantial underpricing. However, the resistance to setting the maximum below the original price, which also is evident in the figure, cannot be explained by the information acquisition hypothesis. We are unaware of any formal theory in the IPO literature to account for this phenomenon. Presumably, the issuer is the one who is resistant to abandoning the original price as a feasible offer price by setting the maximum below it. Thus, the evidence appears to best fit an argument that includes trying to place the IPO at the original price as long as subsequent information is not too negative. This down-side resistance distinguishes rational bargaining around implicit understandings from prospect theory. Prospect theory seeks to explain why the maximum price would not adjust fully to unexpectedly good news, but does not explain why it would not adjust fully to unexpectedly bad news. The resistance to price reductions also distinguishes implicit contracting based on a target price from the hypothesis that price rigidity arises from concern with the opportunity cost of a failed offering. The opportunity cost hypothesis does not imply that resistance to prices that depart from the original price would be any different from resistance to prices that depart from other price levels. Essentially, the opportunity cost hypothesis implies that the original price has no relevance to determination of the filing range. Rather, the range is set in consideration of the risk of a failed offering.

C. Initial Returns

In Panel (c) of Table 4, we report OLS results of the relationship of public information to the *Initial Return*. We use the same variables as in the price formation regressions, and explicitly include *Initial Price*

Adjustment and *Offer Price Adjustment*. To allow for differences in the strength of relationships of *Initial Return* to positive and negative price adjustments, we include variables for positive values of the price adjustment variables. Consistent with the US evidence of partial adjustment, *Initial Return* is positively related to *Offer Price Adjustment*. Like for US IPOs, as discussed above, offer prices adjust more fully to negative than to positive information. As a result, initial returns are positively related to offer price adjustments when the adjustments are positive. For negative offer price adjustments, we cannot reject the hypothesis that the adjustment is full, so that the expected initial return is constant when offer prices are adjusted down.

We also find a significant positive relationship of *Initial Return* to *Initial Price Adjustment* when the adjustment is positive (t-value = 3.25). The relationship is lower when the adjustment is negative, but the difference is only marginally significant.[27] This finding that partial adjustment extends to a period before the start of the underwriter's pre-selling effort is further evidence that early price discussions limit the magnitude of price adjustments occurring after the Preliminary Prospectus.

Figure 5 is a plot of the combined partial effects of *Initial Price Adjustment* and *Offer Price Adjustment* on *Initial Return*. When the combined price adjustment is positive, the slope of the scatter plot is positive, indicating partial adjustment – higher positive price adjustments are associated with higher initial returns. When the combined price adjustment is negative, the slope of the scatter plot is close to zero, indicating nearly full adjustment.

Edelen and Kadlec (2002) hypothesize that asymmetric price adjustment is an artifact attributable to withdrawal of IPOs when prices decline and when the expected cost of holding out for a better price is high. They argue that issuers are more likely to proceed with an IPO when the price change would be positive. While we do not have complete data on withdrawn offerings and some amount of cancellation does occur in response to price declines, the pattern of price adjustments in Figure 5 does not point to cancellation being the explanation for the asymmetric results.[28] In particular, the figure shows a large number of IPOs with negative combined price adjustments but nonetheless with positive partial effects of the adjustments. Further, unless the

[27] Table 4 shows the positive interaction, whereas, for expositional reasons, the significance levels reported in this paragraph of the text are based on respecifying the regressions so that the interaction is on negative values of *Initial Price Adjustment*.

[28] Nomura Securities was able to provide a list of cancellations for the 2001-2003 portion of our sample period. During this period, there were 227 completed JASDAQ IPOs. Eleven IPOs were cancelled: eight due to the effects of 9-11, one in response to a lawsuit filed just before the planned offer date, and four after general market declines unrelated to 9-11. Of the 11, eight (including five from 9-11) were cancelled after the First Revised Prospectus (when the range was published). Also, eight of the 11, including 5 from the 9-11episode, subsequently were completed.

number of cancellations is very large, which it is not, the number of near-zero and positive partial effects when the combined price adjustment is very negative does not appear to be an extension of a truncated linear relationship from the positive side of the figure.

The coefficients on the run-up variables indicate that initial returns are affected by public information about the JASDAQ Index. This result is consistent with US evidence and with earlier discussion that the OLS model of *Offer Price Adjustment* understates the adjustment within the filing range. We tried splitting *Run-up -20 to 0* into positive and negative changes as in Panel (b), but the interacted coefficient was near zero and not significant. Instead, the constraining effect of the filing range maximum on the offer price appears to strengthen the relationship between *Initial Return* and *Positive Values of Offer Price Adjustment*.

Availability of over-allotment and Green Shoe options does not significantly affect *Initial Return*. However, consistent with Lewellen (2006), providing for over-allotment and Green Shoe options does result in significantly lower initial returns. This, again, suggests that underwriters can use the options to reduce price uncertainty and instead can respond to a potentially high initial return by increasing supply.

D. Long-run Returns

Practitioners, along with Loughran and Ritter (2002), Derrien (2005) and others, propose that underwriters may increase the extent of underpricing if they perceive that the market is overheated or that demand for an issuer's shares is excessive. Pricing based on relative value, leaning against the wind, and similar hypotheses imply a negative correlation between initial returns and long-run returns. As reported by Loughran and Ritter (2002), the US evidence on this point provides mixed support. Additionally, the desire to encourage buy-and-hold investors to acquire information could lead issuers and underwriters to price such that the long-run return would compensate buy-and-hold investors for their cost of information acquisition.

In Panel (d) of Table 4 we present a model of the *One-year Aftermarket Return*. The results allow us to distinguish between pricing based on relative value and other hypotheses of underpricing, such as the prospect theory argument of Loughran and Ritter (2002) and the agency cost explanation of Ritter and Welch (2002). While *One-year JASDAQ Return* is the most important explanatory variable, the fact that its coefficient is significantly less than one suggests that the first aftermarket prices are too high relative to long-run value. Table 1 shows that, whereas the mean JASDAQ return was 0.29 over the 12 months, the mean aftermarket IPO return

was negative 0.050. However, the JASDAQ Index was quite volatile over the sample period and included one six-month episode of logged one-year holding-period returns in excess of 200 percent. Thus, the difference in means is affected by a few very positive outliers of the JASDAQ. The difference in median returns between the JASDAQ and the IPO issues is much smaller, only 0.037.

The most important other factors affecting the long-run return are the initial returns and the price adjustments.[29] As with the other models in Table 4, we allow the effects of positive and negative adjustments to be different. The exposition is clearest in chronological order. First, the effect of *Initial Price Adjustment* is negative but near zero for downward adjustments (that is, a positive coefficient of 0.1557 is applied to a negative initial price adjustment such as -0.10, so that the one-year aftermarket return is expected to be lower by 0.0156). The expected aftermarket return also is negative for positive adjustments: a combined coefficient of -0.6017 (=0.1557 - 0.7574) is applied to a positive initial price adjustment such as 0.10, so that the one-year aftermarket return is expected to be lower by 0.0602. The difference between the positive and negative coefficients is statistically significant at the 0.10 level (t-value = 1.70). The evidence indicates that revision in either direction is associated with lower expected long-run returns. The result suggests that initial price adjustments reflect improvements in pricing accuracy relative to long-run value. The result is consistent with Benveniste and Spindt (1989), Sherman and Titman (2002), Jenkinson, et al. (2006), and other hypotheses concerning the potential for the roadshow to improve pricing accuracy.

Second, the effect of O*ffer Price Adjustment* is strictly negative and significantly stronger for negative than for positive adjustments. Thus, downward adjustments of the offer price have the empirical (i.e., non causal) partial effect of increasing long-run returns (the negative coefficient times a negative offer price adjustment), whereas the empirical partial effect of upward adjustments is close to zero because the positive and negative coefficients almost cancel. The near-zero relationship for issues with upward adjustments indicates that upward adjustments are not significantly related to long-run returns. The significant negative coefficient when offer prices are adjusted down is most consistent with concerns about over-pricing and with the objective of encouraging information acquisition by buy-and-hold investors.

[29] The results in Panel (d) are not materially altered by inclusion of the market run-up variables and the coefficients on those variables are not statistically significant at conventional levels.

Third, the effect of initial returns on long-run returns also is strictly negative, but only significant when initial returns are positive. The relationship is near zero when the initial return is negative. The result augments the evidence presented in Figure 5 that downward offer price adjustments are essentially full, and upward offer price adjustments are partial. This additional evidence indicates that the downward adjustments also are consistent with long-run value, and that the partial nature of upward adjustments is affected by concern about investor over-optimism.

One reason for partial adjustments of the filing range and the offer price is to compensate for over-optimism among investors. As shown in Table 1, the mean one-year total return (including the initial return) is positive, but lower than the one-year JASDAQ return, whereas the median one-year total return is more positive, compared to a negative JASDAQ median return. Thus, the mean difference in performance relative to the JASDAQ Index is driven by some extreme outliers.

To assess the hypothesis that offer prices reflect attempts to compensate for over-optimism, Table 5 provides descriptive data and statistical tests of the relationships between price adjustments and initial and long-run returns. As background, the correlation between one-year returns and initial returns is -0.29 and is highly significant. Both *Initial Price Adjustment* and O*ffer Price Adjustment* are positively related to *Initial Return* but negatively related to *One-year Aftermarket Return*, but both are more highly correlated with *Initial Return*. To assess pricing based on relative value, we show how the price adjustments relate to T*otal Return*. Compared to either the initial or the one-year return, the relationships of price adjustments to *Total Return* are weaker. Ultimately, although the IPOs with the greatest price adjustments have the most positive initial returns, they have the lowest total returns. While the correlation between *Total Adjustment* and *Total Return* is statistically significant, it is low in terms of economic significance.

Our evidence suggests that even though the price adjustments are partial, when measured against the initial returns, the mean under-adjustment relative to the initial return is more than offset by mean under-performance in the year after the IPO. However, when we group observations based on total price adjustments into large negative, large positive, and near zero subsamples, all three subsamples have median total returns that are positive and substantially higher than the corresponding median one-year JASDAQ returns over the same period. Similar comparisons of mean total returns of the subsamples tell a less-clear story. Because the

observations of one-year returns are not independent of each other over time and our sample period is limited to about six years, it is not possible to conclusively determine whether underwriters attempt to underprice relative to value one year later, adjusted for changes in the JASDAQ. Based on the skewness of the one-year JASDAQ returns, the comparison of medians appears to be a more reliable indicator. Table 5 results indicate that the one-year IPO returns exceed the corresponding one-year JASDAQ Index returns, as is implied by the hypothesis that underwriters underprice to encourage information acquisition by buy-and-hold investors.

VI. Conclusion

We examine the pricing of 487 book-built JASDAQ IPOs and analyze the price formation process extending back to preliminary pricing that occurs after the beauty contest but before the roadshow. The data allow us to examine aspects of the price formation process that are not observable when looking only at US offers. We examine the determinants of price adjustments from the original price to the filing range and from the filing range to the offer price, as well as how initial returns and long-run returns relate to the price adjustments. We find that IPO prices are under-adjusted relative to public information that extends back to at least four months before the offer. Controlling for other factors, the IPOs with the highest initial returns have the lowest JASDAQ-adjusted returns over the year after the IPO. Overall, the evidence indicates that price adjustments are limited by prior implicit agreements among the relevant parties to the offering: the issuer, the underwriter, and the investors.

The unique database allows us to test four hypotheses, which are widely discussed in the literature as offering explanations for aspects of underpricing and partial adjustment: 1) pricing to produce incentives for investors to acquire and disclose information about issuing firms; 2) pricing that reflects an anchoring bias associated with the original public mention of an offer price; 3) pricing in response to opportunity cost of failed offerings; and 4) pricing based on value relative to other publicly traded shares.

We find that, in Japan, adjustment of the offer price is constrained by both the maximum and minimum prices of the filing range. It appears that the bounds and width of the range are affected by earlier price discussions and by the desire to commit to compensate investors for costly information acquisition and disclosure. We study the determinants of the width of the range and find that the range is wider for riskier IPOs. Because the filing range constraint often is binding on the upside, the offer price cannot fully adjust to positive

market-wide news once the range is set. In some cases, this constraint results in a pattern of partial adjustment on the upside and almost full adjustment on the downside. The pattern of adjustment looks similar to what is observed for US IPOs and has been characterized by Loughran and Ritter (2002) as leaving money on the table; by Sherman and Titman (2002) and others as compensating investors for information acquisition and disclosure; and by Edelen and Kadlec (2005) as concern with the opportunity cost of a failed offering combined with selection bias. The Japan evidence is consistent with the hypothesis of Sherman and Titman. The evidence does not appear to support the prospect theory hypothesis but is consistent with the opportunity cost argument of Edelen and Kadlec, except that we do not find that the asymmetric response to good and bad news is due to cancelled offerings.

US institutions with respect to pricing outside the range are less exacting so that the effect of the range on partial price adjustment is harder to discern. However, the Japanese evidence suggests that implicit contracting to limit price adjustments and to encourage information acquisition could partly account for episodes of high underpricing in the US. Implicit contracting is not mutually exclusive with other hypotheses. The prospect-theory-based argument of Loughran and Ritter (2002), for example, can account for partial adjustment after the filing range is set, but unless the issuer's anchoring bias extends back to the early price discussions, it cannot account for the failure of offer prices to incorporate information from before the filing range was established. It also does not explain resistance to lowering the maximum of the range relative to the original price, or why issuers publicly commit to a filing range maximum that is likely to provide high returns to investors.

Sustained periods of very high underpricing, such as during the US high-tech rally, require a different explanation, one that addresses the question of why underwriters do not set higher filing ranges during periods when other recent IPOs are generating very high initial returns. Preliminary discussions with the underwriter normally start a few months before the IPO, and appear to result in implicit contracts that include pricing based on the relative values of established public firms around the time of the beauty contest. Pricing based on relative value can result in long episodes of unusually high underpricing. Some other explanations for persistent underpricing in the US such as spinning and directed stock programs, as described by Ritter and Welch (2002), appeal to agency costs as a reason issuers would agree in advance to IPO prices that they know are too low.

However, agency cost does not suggest that high initial returns can predict long-run returns. US evidence on the relationship between initial returns and long-run returns, while generally consistent with our findings, is less clear and more strongly supports agency-cost-based explanations for underpricing in the US.

The tension that exists between pricing based on relative value and implicit contracting dictates that certification of the consistency of the offer price with relative value can only hold on average and that some IPOs can be predictably overpriced. As hypothesized by Benveniste and Spindt (1989), and others, the underwriter's control over allocations is necessary if underpricing is to be used to compensate investors for sometimes buying overpriced IPO shares. In our analysis, the commitment not to price above the maximum of the range can function as a device to assure average underpricing, whether allocations are used to compensate investors for producing and revealing their private information or only to reward disclosure.

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Table 1

Descriptive Statistics for the IPO Sample and Bivariate Tests of Differences between the Two Subsamples: IPOs from the Pre-over-allotment Period and IPOs from the Over-allotment Period

The sample includes all 487 IPOs on JASDAQ from the beginning of the book-building regime on September 30, 1997, through the end of 2003. The sample includes 357 issues from the period through January 31, 2002, when over-allotment and Green Shoe options were not permitted (the Pre-Over-allotment Period), and 130 issues from the period beginning February 1, 2002, when over-allotment and Green Shoe options were permitted (the Over-allotment Period). Varable definitions are provided in the first column of the table. All returns and price adjustments are measured in natural logs. Returns over time are measured as natural logs of buy-and-hold returns. Day 0 is the first trading day.

	Full Sample				Pre-Over-allotment Period			Over-allotment Period						
	Mean	Median	Standard Deviation	Skewness	Mean	Median	Standard Deviation	Mean	Median	Standard Deviation	t-stat	p-value	Wilcoxon z-stat	p-value
Initial Price Adjustment (Ln of (Midpoint/Original Price))	-0.021	-0.024	0.174	0.025	-0.003	0.000	0.192	-0.070	-0.060	0.096	5.13	0.00	4.71	0.00
Offer Price Adjustment (Ln (Offer Price/Midpoint of Range))	0.051	0.066	0.078	-0.861	0.052	0.069	0.084	0.048	0.064	0.058	0.52	0.61	2.16	0.03
Total Price Adjustment (Initial Adjustment plus Offer Price Adjustment)	0.030	0.018	0.200	-0.018	0.049	0.051	0.218	-0.022	0.000	0.123	4.51	0.00	3.93	0.00
Initial Return (Ln (Market Price/Offer Price))	0.255	0.134	0.417	1.404	0.268	0.140	0.443	0.218	0.122	0.334	1.33	0.19	0.77	0.44
One-year Aftermarket Return (Ln of price ratio)	-0.050	-0.059	0.905	0.173	-0.146	-0.128	0.884	0.215	0.204	0.913	-3.89	0.00	-3.93	0.00
Total Return (Initial Return plus One-year Aftermarket Return)	0.205	0.117	0.878	0.477	0.122	0.049	0.867	0.433	0.373	0.873	-3.49	0.00	-3.60	0.00
Filing Range (Ln (Maximum/Minimum))	0.203	0.182	0.096	1.799	0.217	0.200	0.101	0.162	0.147	0.069	6.83	0.00	6.41	0.00
Run-up -20 to 0 (Ln of price ratio)	-0.001	-0.010	0.102	0.077	-0.001	-0.011	0.113	-0.002	-0.009	0.063	0.18	0.86	-0.54	0.59
Run-up -40 to -20 (Ln of price ratio)	-0.003	-0.147	0.094	0.679	-0.002	-0.021	0.100	-0.006	-0.004	0.074	0.48	0.63	-0.30	0.77
Run-up -60 to -40 (Ln of price ratio)	0.006	-0.012	0.102	0.784	0.001	-0.021	0.109	0.021	0.007	0.077	-2.23	0.03	-3.34	0.00
Run-up -80 to -60 (Ln of price ratio)	0.003	-0.012	0.103	0.288	-0.003	-0.018	0.114	0.020	0.013	0.059	-2.85	0.00	-3.53	0.00
Run-up -100 to -80 (Ln of price ratio)	0.000	-0.011	0.090	0.955	0.002	-0.014	0.100	-0.003	-0.008	0.051	0.66	0.51	-0.76	0.45
Standard Deviation of JASDAQ-Adjusted Returns (Ln returns)	0.258	0.188	0.224	2.454	0.256	0.182	0.228	0.262	0.196	0.214	-0.36	0.72	1.89	0.06
One-year JASDAQ Return (Ln of price ratio)	0.294	-0.096	0.818	1.564	0.209	-0.147	0.891	0.528	0.489	0.500	-4.95	0.00	-8.30	0.00
Firm Age (Years)	24.372	22.170	14.814	0.667	25.095	23.000	15.007	22.387	19.875	14.148				
Firm Age (Ln of years)	2.963	3.099	0.748	-0.753	3.000	3.150	0.737	2.860	2.990	0.772	1.75	0.08	1.74	0.08
Offer Size (Billion yen)	2.596	1.062	6.992	10.011	2.951	1.105	0.799	1.618	0.864	2.606				
Offer Size (Ln of million yen)	13.933	13.876	1.120	0.711	14.010	13.920	1.149	13.710	13.650	1.010	2.17	0.01	2.34	0.02
Number of IPOs in Prior Three Months	19.384	19.000	7.148	-0.006	21.200	21.000	7.021	16.077	16.000	5.039	7.63	0.00	6.83	0.00
Underwriter Market Share (fraction of IPOs)	0.159	0.195	0.111	-0.619	0.170	0.220	0.107	0.128	0.195	0.117	3.58	0.00	3.21	0.00
Underwriter Fee (Ln (Fee/Offer Price))	0.058	0.058	0.005	0.207	0.057	0.058	0.004	0.061	0.058	0.004	-9.60	0.00	-8.62	0.00
Over-allotment Period (equals one during period allowed)	0.267	0.000	0.443	1.054										
Over-allotment Option (equals one if provided for in the Prospectus)	0.088	0.000	0.284	2.902				0.331	0.000					
Over-allotment Exercise (equals one if short covered)	0.037	0.000	0.189	4.909				0.138	0.347					
Green Shoe Option Exercise (equals one if exercised)	0.078	0.000	0.268	3.146				0.292	0.457					

Table 2

Descriptive Statistics for IPOs from the Over-Allotment Period and Bivariate Tests for Differences between Two Subsamples: IPOs that Provide for Over-Allotment and Green Shoe Options and IPOs that Do Not

The sample includes 130 IPOs on JASDAQ from February 1, 2002, when over-allotment options were permitted, through the end of 2003. The sample includes 87 issues that did not include over-allotment and Green Shoe options and 43 issues that included over-allotment and Green Shoe options. Varable definitions are provided in the first column of the table. All returns and price adjustments are measured in natural logs. Returns over time are measured as natural logs of buy-and-hold returns. Day 0 is the first trading day.

	Without Over-Allotment and Green Shoe Options		With Over-Allotment and Green Shoe Options					
	Mean	Standard Deviation	Mean	Standard Deviation	t-stat	p-value	F-stat	p-value
Initial Price Adjustment (Ln of (Midpoint/Original Price))	-0.082	0.101	-0.046	0.081	-2.23	0.03	-1.74	0.08
Offer Price Adjustment (Ln (Offer Price/Midpoint of Range))	0.050	0.063	0.043	0.047	0.71	0.48	1.36	0.17
Total Price Adjustment (Initial Adjustment plus Offer Price Adjustment)	-0.032	0.129	-0.002	0.109	-1.36	0.17	-1.14	0.25
Initial Return (Ln (Market Price/Offer Price))	0.244	0.362	0.168	0.266	1.35	0.18	0.10	0.33
One-year Aftermarket Return (Ln of price ratio)	0.138	0.970	0.369	0.772	-1.47	0.14	-1.57	0.12
Total Return (Initial Return plus One-year Aftermarket Return)	0.382	0.910	0.537	0.794	-1.00	0.32	-1.39	0.16
Filing Range (Ln (Maximum/Minimum))	0.174	0.075	0.138	0.045	3.43	0.00	2.66	0.01
Run-up -20 to 0 (Ln of price ratio)	-0.007	0.061	0.007	0.067	-1.17	0.25	-1.09	0.28
Run-up -40 to -20 (Ln of price ratio)	-0.003	0.067	-0.012	0.086	0.60	0.55	0.39	0.70
Run-up -60 to -40 (Ln of price ratio)	0.004	0.062	0.054	0.093	-3.13	0.00	-2.81	0.01
Run-up -80 to -60 (Ln of price ratio)	0.013	0.058	0.033	0.061	-1.73	0.09	-1.79	0.07
Run-up -100 to -80 (Ln of price ratio)	-0.009	0.051	0.010	0.050	-2.03	0.05	-2.05	0.04
One-year JASDAQ Return (Ln of price ratio)	0.471	0.518	0.643	0.446	-1.96	0.05	-1.62	0.11
Standard Deviation of Abnormal Returns (Ln returns)	0.272	0.236	0.249	0.160	0.66	0.51	-0.67	0.50
Firm Age (Ln of years)	2.788	0.764	3.014	0.774	-1.58	0.12	-1.86	0.06
Offer Size (Ln of million yen)	13.541	1.009	14.065	0.929	-2.94	0.00	-3.36	0.00
Number of IPOs in Prior Three Months	16.678	16.000	14.860	15.000	2.01	0.05	1.35	0.18
Underwriter Market Share (fraction of IPOs)	0.090	0.112	0.205	0.088	-6.41	0.00	-5.45	0.00
Underwriter Fee (Ln (Fee/Offer Price))	0.061	0.003	0.062	0.005	-2.08	0.04	-2.11	0.03
Standard Deviation of JASDAQ-Adjusted Returns (Ln returns)	0.272	0.236	0.249	0.160	0.66	0.51	-0.67	0.50
Over-allotment Exercise (equals one if covering short)			0.042	0.499				
Green Shoe Option Exercise (equals one if exercised)			0.884	0.324				

Table 3

Descriptive Data on Price Formation of Japanese IPOs

The original price is reported in the Preliminary Prospectus. The filing range is reported in the First Revised Prospectus. The final offer price is announced in the Second Revised Prospectus. The sample includes all 487 JASDAQ IPOs from the start of Japan's book-building regime in October 1997 through the end of 2003.

Initial Price Adjustment	**Number of IPOs**	**Percent of IPOs**
Minimum of Range > Original Price	76	15.6%
Minimum of Range = Original Price	44	9.0%
Minimum < Original < Maximum	173	35.5%
Maximum of Range = Original Price	93	19.1%
Maximum of Range < Original Price	101	20.7%
	487	

Offer Price Adjustment	**Number of IPOs**	**Percent of IPOs**
Offer Price = Maximum of Range	330	67.8%
Minimum < Offer < Maximum	115	23.6%
Offer Price = Minimum of Range	42	8.6%
	487	

Initial Return	**Number of IPOs**	**Percent of IPOs**
Number Positive	388	79.7%
Number Zero	25	5.1%
Number Negative	74	15.2%
	487	

Correlations	**Coefficient**	**p-value**
Ln(Midpoint/Original) with Ln(Offer/Midpoint)	0.1241	0.006***
Ln(Offer/Midpoint) with Ln(Initial Return)	0.2869	0.000***
Ln(Midpoint/Original) with Ln(Initial Return)	0.3072	0.000***

Table 4

Estimates of Price Adjustment, Filing Range, Initial Return, and Long-run Return

The table reports (a) 3SLS and OLS estimates of models of the price change from the Preliminary Prospectus to the midpoint of the filing range; (b) Censored maximum likelihood and OLS estimates of models of the price adjustment from the midpoint of the filing range in the First Revised Prospectus to the offer price in the Second Revised Prospectus. The price change is censored from above and below because the offer price cannot be above the maximum or below the minimum of the filing range; (c) OLS estimates of models of the initial return from offer price to the first aftermarket price; (d) the one-year return from the first aftermarket price to the price one year later. Estimates are based on all 487 IPOs from the October 1997 start of Japan's book-building regime through the end of 2003. All returns and price adjustments are measured as natural logs of buy-and-hold returns. Day 0 is the first trading day. t-values of OLS regressions are based on clustered, robust estimators, where the data are assumed to be clustered by calendar quarter. One-tailed significance levels are as follow: * = .10, ** = .05, and *** = .01.

	Panel (a)				Panel (b)				Panel (c)		Panel (d)	
	Initial Price Adjustment (Price Change from Original Price to Midpoint of Filing Range)				*Offer Price Adjustment* (Price Change from Midpoint of Range to Offer Price)				*Initial Return* (Price Change from Offer Price to First Closing Price)		*One-year Aftermarket Return*	
	3SLS		OLS		Censored Model		OLS		OLS		OLS	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Initial Price Adjustment (Ln(Midpoint/Original Price))					-0.0368	-0.36	-0.0132	-0.35	0.2042	1.25	0.1557	0.50
Positive Values of Initial Price Adjustment					0.1335	0.63	-0.0124	-0.31	0.3415	1.40*	-0.7574	-1.70*
Offer Price Adjustment (Ln(Offer Price/Midpoint))									-0.4523	-0.91	-3.3708	-3.54***
Positive Values of Offer Price Adjustment									2.4085	3.32***	3.0396	1.96**
Initial Return (Ln(First Market Price/Offer Price))											-0.0638	-0.27
Positive Values of Initial Return											-0.5035	-1.65*
Filing Range (Ln(Maximum/Minimum))	-0.3427	-1.42*	-0.2023	-2.21**	0.1230	1.05	0.2539	5.29***	-0.4594	-2.32**		
Run-up -20 to 0 (Ln(P(0)/P(-20)))					0.8892	4.02***	0.2363	2.18**	1.1978	3.97***		
Positive Values of Run-up -20 to 0					-0.8400	-2.10**	-0.1850	-1.33*				
Run-up -40 to -20 (Ln of price ratio)	0.5279	6.70***	0.5563	6.14***	0.9630	6.14***	0.2082	3.88***	0.4554	2.83***		
Run-up -60 to -40 (Ln of price ratio)	0.3557	5.13***	0.3550	3.89***	0.6646	5.20***	0.1599	3.14***	0.3294	1.52*		
Run-up -80 to -60 (Ln of price ratio)	0.2162	3.19***	0.2266	2.66***	0.3259	2.44***	0.0458	1.06	0.4467	2.11**		
Run-up -100 to -80 (Ln of price ratio)	0.1445	1.91**	0.1383	1.37*								
One-year JASDAQ Return (Ln of price ratio)											0.5179	7.06***
Offer Size (Ln of million yen)	0.0081	1.23	0.0089	1.24	0.0509	4.69***	0.0168	2.61***	-0.0270	-1.46*		
Underwriter Market Share (fraction of IPOs)	0.0032	0.05	0.0151	0.19	-0.3141	-2.93***	-0.0740	-2.44**	-0.0083	-0.06	0.0977	0.40
Underwriter Fee (Ln(Fee/Offer Price))	2.5516	1.35*	3.1252	1.43*	13.9149	5.05***	4.2721	2.53***	-2.6443	-0.88	15.5766	1.32*
Over-allotment Period (= 1 during period allowed)	-0.1019	-4.75***	-0.0967	-3.66***	-0.0348	-1.02	-0.0084	-0.67	0.0120	0.24	0.0672	0.40
Over-allotment Option (= 1 if provided for in Prospectus)	-0.0042	-0.15	-0.0016	-0.11	-0.0339	-0.67	-0.0133	-1.12	-0.1009	-2.04**	0.0626	0.48
Constant	-0.1874	-0.98	-0.2626	-1.39*	-1.2469	-5.08***	-0.4606	-2.55***	0.7311	2.16**	-0.9692	-1.36*
Adj R^2 or Pseudo R^2	0.280		0.285		0.413		0.283		0.301		0.350	

	Filing Range			
	3SLS		OLS	
	Coefficient	t-value	Coefficient	t-value
Initial Price Adjustment (Ln (Midpoint/Original Price))	-0.1306	-1.49*	-0.0699	-1.90**
Absolute Value of Initial Price Adjustment	0.1631	4.51***	0.1484	3.27***
Run-up -100 to -20 (Ln of price ratio)	-0.0293	-1.47*	-0.0390	-3.07***
Firm Age (Ln of years)	-0.0107	-2.11**	-0.0110	-1.53*
Offer Size (Ln of million yen)	-0.0059	-1.43*	-0.0067	-1.19
Number of IPOs In Prior Three Months	-0.0016	-2.63***	-0.0018	-1.95**
Start of Data Series (Control for first 3 Months)	0.0004	1.36*	0.0006	2.26**
Underwriter Market Share (fraction of IPOs)	-0.0628	-1.67**	-0.0678	-1.62*
Underwriter Fee (Ln (Fee/Offer Price))	-2.7633	-2.60***	-2.8139	-2.74***
Standard Deviation of Abnormal Returns (Ln returns)	0.0310	1.63*	0.0374	2.72***
Over-allotment Period (= 1 during period allowed)	-0.0521	-3.58***	-0.0490	-5.05***
Over-allotment Option (= 1 if provided for in Prospectus)	-0.0088	-0.53	-0.0095	-0.72
Constant	0.4995	5.04***	0.5206	3.99***
Adj R^2	0.235		0.244	

Table 5

Relationship of Price Adjustments to Initial and Long-Run Returns

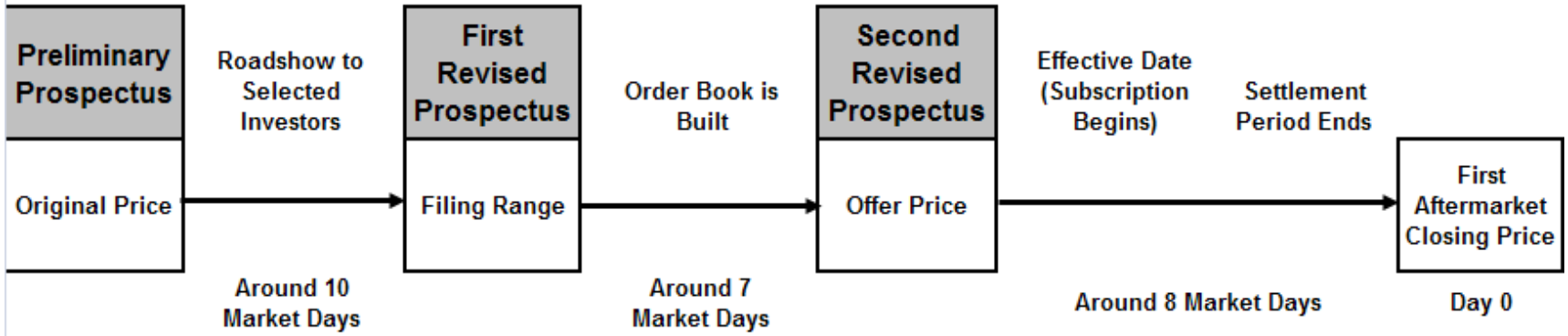
The table shows comparisons of mean and median *Initial Return*, *One-year Aftermarket Return,* and *Total Return* for high, medium, and low price adjustments. *Total Return* is *Inital Return* plus *One-year Aftermarket Return*. *Total Adjustment* is *Initial Price Adjustment* plus *Offer Price Adjustment*. Based on a sample of 487 JASDAQ IPOs from September 30, 1997 through 2003. All data are measured in natural logs of buy-and-hold returns.

	Initial Adjustment	Obs.	Adjustment	Initial Return	Aftermarket Return	Total Return	One-year JASDAQ
Mean	<-.05	202	-0.168	0.138	0.033	0.172	0.286
		150	-0.005	0.239	0.097	0.336	0.389
	>=.05	135	0.182	0.447	-0.337	0.110	0.212
	Pearson Correlation			.31***	-.19***	-.08*	
Median	<-.05		-0.143	0.063	0.000	0.143	-0.096
			0.000	0.138	0.013	0.181	0.041
	>=.05		0.154	0.302	-0.359	0.000	-0.166
	Spearman Rank Correlation			.30***	-.17***	-.08*	
	Offer Price Adjustment						
Mean	<-.0	92	-0.083	0.014	0.388	0.402	0.318
		281	0.061	0.304	-0.158	0.146	0.307
	>=.10	114	0.132	0.328	-0.137	0.191	0.243
	Pearson Correlation			.29***	-.20***	-.12***	
Median	<-.0		-0.080	0.033	0.216	0.244	-0.103
			0.065	0.178	-0.130	0.090	-0.069
	>=.10		0.123	0.201	-0.175	0.131	-0.107
	Spearman Rank Correlation			.28***	-.23***	.17***	
	Total Adjustment						
Mean	<-.10	105	-0.238	0.025	0.277	0.303	0.329
		231	0.009	0.217	-0.011	0.206	0.296
	>=.10	151	0.248	0.473	-0.337	0.136	0.266
	Pearson Correlation			.38***	-.24***	-.12***	
Median	<-.10		-0.201	0.033	0.203	0.208	-0.091
			0.000	0.120	-0.011	0.134	-0.070
	>=.10		0.223	0.325	-0.359	0.023	-0.140
	Spearman Rank Correlation			.39***	-.25***	-.14***	

Figure 1

The Japanese Book-building Process for Initial Public Offerings on JASDAQ

Since September 30, 1997, JASDAQ IPOs have been issued by book-building In the Japanese book-building process, an original price is reported in a Preliminary Prospectus that normally is circulated about 25 market days before the IPO. The filing range is reported in a First Revised Prospectus that normally is circulated about 15 market days before the IPO. The final offer price is announced in a Second Revised Prospectus that is circulated a few days before the IPO. The issue is pre-sold in a roadshow that begins after the Preliminary Prospectus is issued and ends before the Second Revised Prospectus is issued.



Technical Notes:

Japanese securities law provides that an offer cannot become "effective" until at least 15 days after the Preliminary Prospectus is filed. The Effective Date normally is the day after the Second Revised Prospectus is filed.

The Commercial Code of Japan (now the Company Act) provides that the opportunity to make payment for shares distributed in an IPO cannot end sooner than two weeks after the First Revised Prospectus is filed.

Aftermarket trading normally begins the day after expiration of the settlment period.

Generally, participation in roadshows is limited to selected institutional investors. Nomura is unique among the three majors in also excluding individual investors from the order book.

Figure 2

Filing Range in Yen per Share and in Natural Logs

for 487 JASDAQ IPOs from September 30, 1997 through December 31, 2003

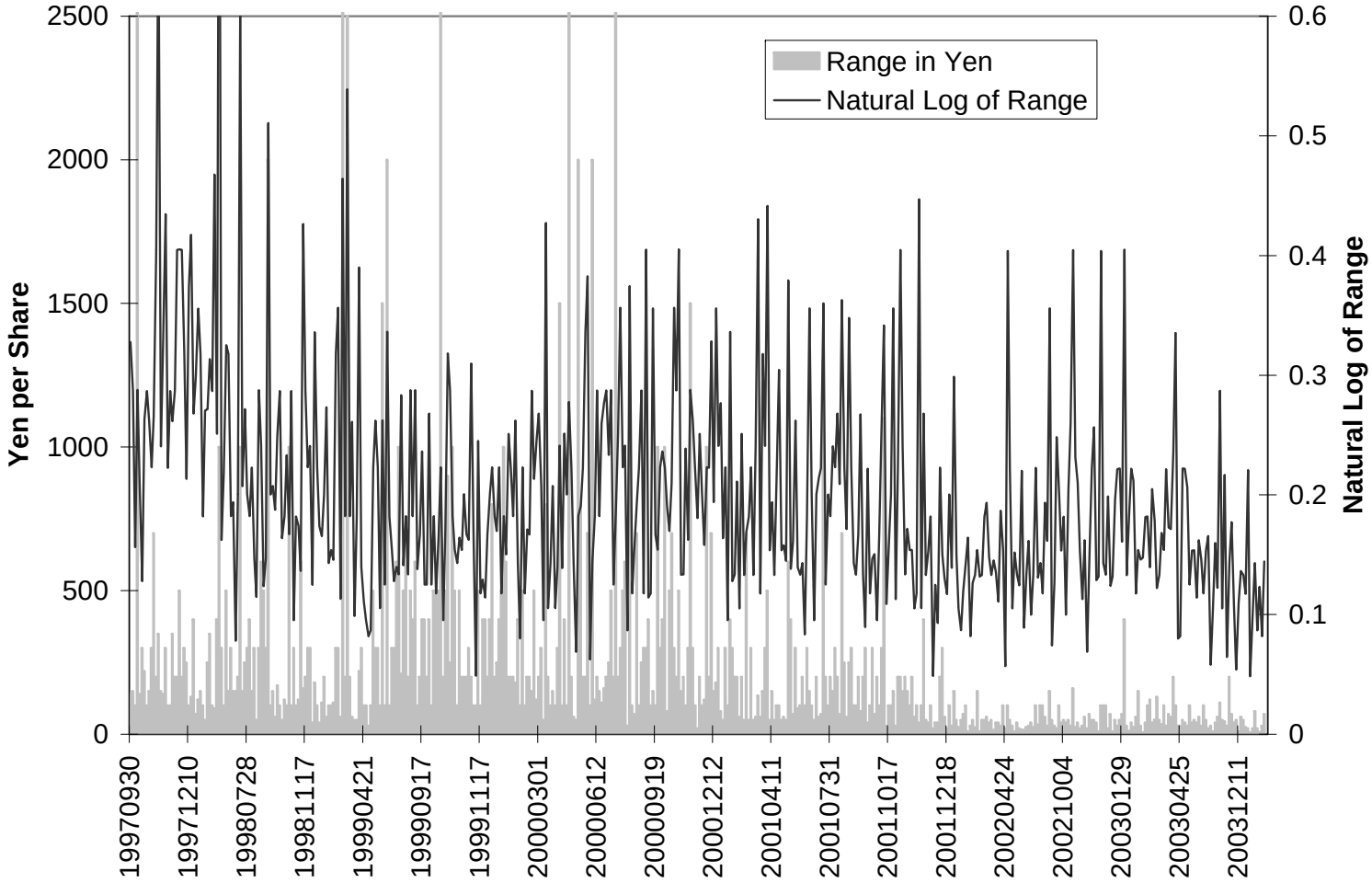


Figure 3

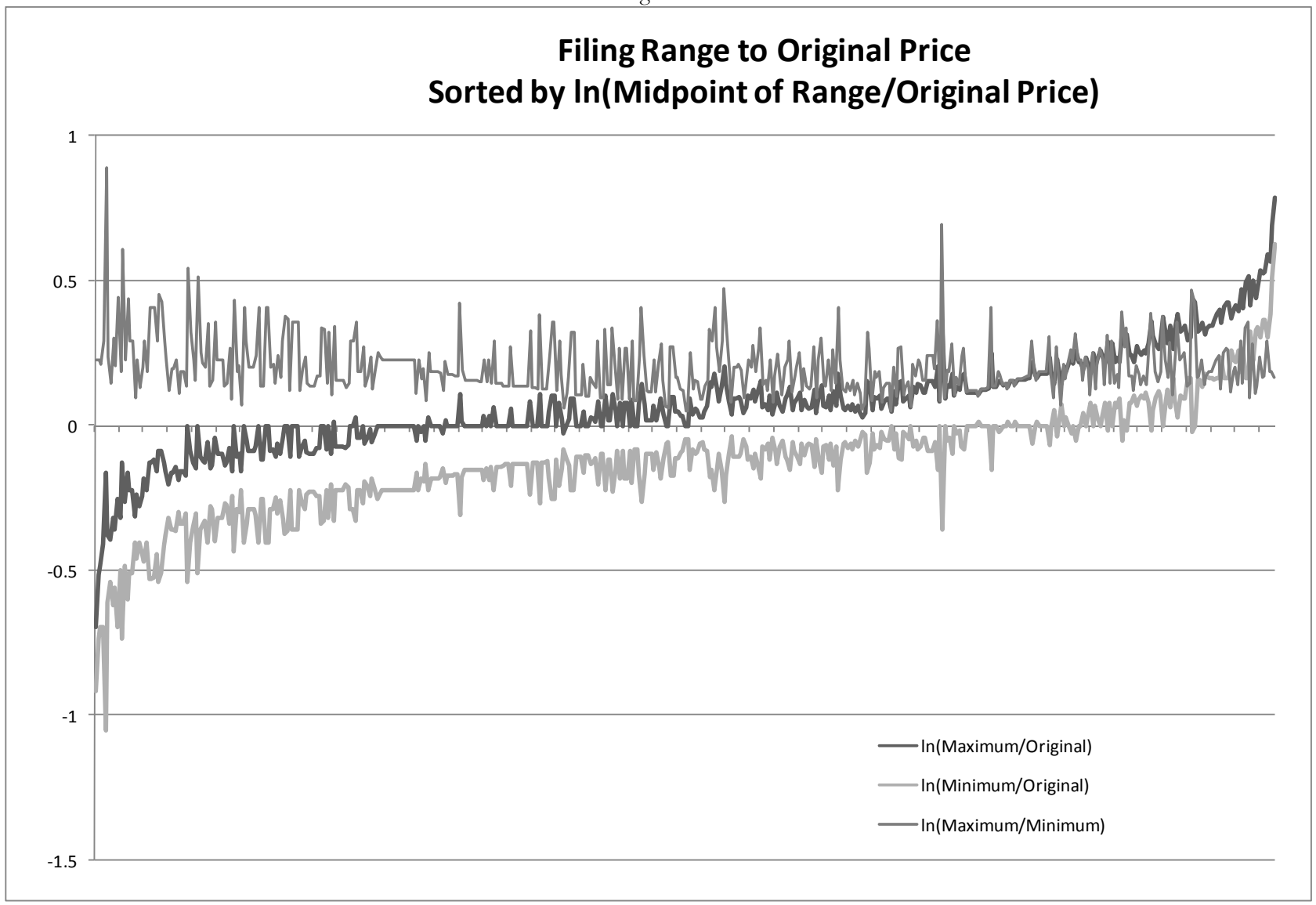

Filing Range to Original Price
Sorted by ln(Midpoint of Range/Original Price)
1
0.5
0
-0.5
-1
-1.5
ln(Maximum/Original)
ln(Minimum/Original)
ln(Maximum/Minimum)

Figure 4

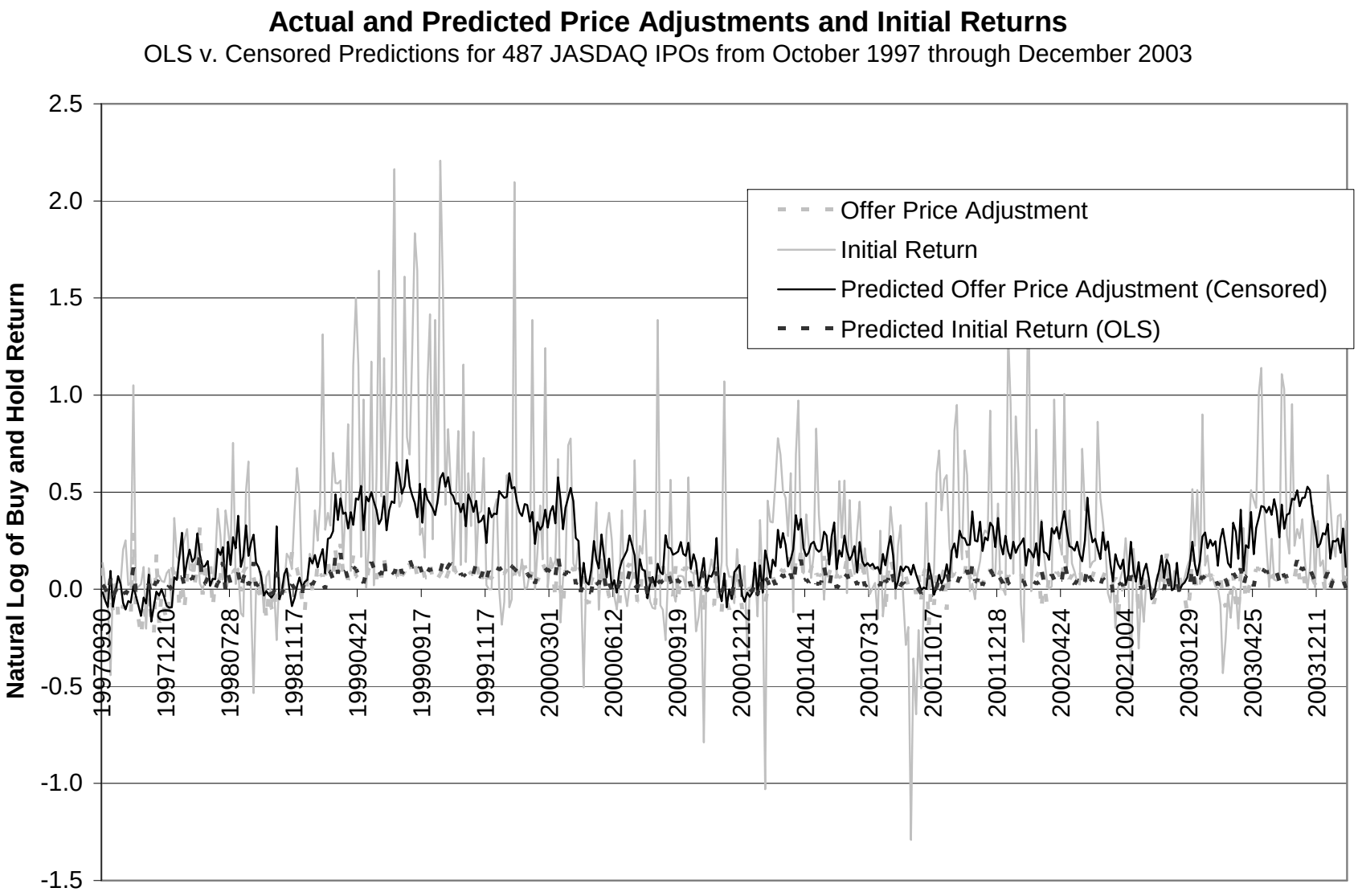

Actual and Predicted Price Adjustments and Initial Returns
OLS v. Censored Predictions for 487 JASDAQ IPOs from October 1997 through December 2003
Natural Log of Buy and Hold Return
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
Offer Price Adjustment
Initial Return
Predicted Offer Price Adjustment (Censored)
Predicted Initial Return (OLS)
19970930
19971210
19980728
19981117
19990421
19990917
19991117
20000301
20000612
20000919
20001212
20010411
20010731
20011017
20011218
20020424
20021004
20030129
20030425
20031211

Figure 5

Partial Relationship of Initial Return to Total Price Adjustment from Original Price to Offer Price

Predictions for 487 JASDAQ IPOs from October 1997 through 2003