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Bookbuilding: How Informative Is the Order Book?

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ABSTRACT

We examine the institutional bids submitted under the bookbuilding procedure for a sample of international equity issues. We find that information in bids which include a limit price, especially those of large and frequent bidders, affects the issue price. Oversubscription has a smaller but significant effect for IPOs. Public information affects the issue price to the extent that it is reflected in the bids. Oversubscription and demand elasticity are positively correlated with the first-day aftermarket return, and demand elasticity is negatively correlated with aftermarket volatility. Our results support the view that bookbuilding is designed to extract information from investors.

INVESTMENT BANKS ACTING AS UNDERWRITERS in securities offerings conduct the preliminary analysis, choose the offer price, allocate the shares, and stabilize the aftermarket price. In this paper, we focus on one of the crucial roles of the underwriter, bookbuilding, and investigate its purpose.

In the bookbuilding procedure, before setting the issue price for an equity offering, the investment bank announces an indicative price range and institutional investors submit bids for shares. Each bid is a request for a quantity of shares, and may include a limit price. Once the bookbuilding process is concluded, the investment bank aggregates the bids into a demand curve and chooses the issue price. Thus, the investment banker has a considerable amount of information available at the time he chooses the price. The price is not set according to any prespecified rule, but at the discretion of the investment banker in consultation with the issuing firm.

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Benveniste and Spindt (1989) and Spatt and Srivastava (1991) argue that bookbuilding is a mechanism that allows the investment banker to extract information from investors which will be helpful in pricing the issue accurately, thus reducing the adverse selection among investors. An alternative view is that, since the underwriter already has privileged information about the issuing firm and its expected cash flows, the purpose of bookbuilding is not to collect further information, but rather to manage the placement of the issue.

In this paper, we investigate whether there is evidence for the information-extraction hypothesis. We analyze the books for 63 international equity issues from a major European investment bank. We first examine whether the investment banker uses the information in the book to set the issue price and the type of information that is most relevant. We then look at the distinction between public and private information. Finally, we consider how the information in the book is reflected in the aftermarket price.

We find that the investment bank relies heavily on the information contained in the bids when setting the issue price. In fact, bids account for most of the cross-sectional variation in offer prices (relative to the initial indicative price range). Limit prices submitted by bidders have a particularly strong influence on the issue price. The price is set close to the quantity-weighted average of limit prices. Moreover, the investment bank relies more on the average limit price when the bids show a consensus among investors. The level of oversubscription (total demand for shares divided by total supply) also affects the offer price, but to a lesser degree.

We distinguish between different types of bids and find that the issue price is influenced particularly by large bids and bids submitted by investors who frequently participate in the bookbuilding exercise. Since Cornelli and Goldreich (2001) find that the investment banker favors certain bids when allocating shares, we also distinguish between bids that receive a favorable allocation and those that do not. We find that the bids that most influence the issue price are the ones which are favored in the allocation of shares. This is consistent with Benveniste and Spindt (1989), who argue that investors supply information in exchange for a more favorable allocation.

We then distinguish between public and private information. Previous studies (Loughran and Ritter (2002) and Lowry and Schwert (2002)) find that the issue price and the following first-day aftermarket return are affected by public information, such as market index returns and industry. The relation between public information and the first-day aftermarket return suggests that the issue price only partially adjusts to public information. Loughran and Ritter argue that while partial adjustment to private information is consistent with Benveniste and Spindt (1989), as compensation for information revelation, partial adjustment to public information is not. We find that investors' bids react to public information and that the underwriter, when setting the issue price, relies on this reaction rather than on the public information itself. This suggests that the line between private and public information is somewhat blurred, and the relation between public information and aftermarket return is not necessarily evidence against the information-extraction hypothesis.

To argue that bookbuilding is a process that allows the investment banker to price the issue more accurately, we also need to show that the information in the bids is not misleading. Therefore, we examine whether there is information in the bids that is not completely summarized in the issue price and can predict first-day aftermarket returns. We find that precisely the information least used in setting the issue price helps predict aftermarket returns. In particular, the level of oversubscription is positively correlated with aftermarket returns, which indicates that the issue price only partially reflects the information in oversubscription. Another variable that predicts aftermarket returns is elasticity of demand, which we interpret as a measure of the consensus among bidders about the stock's value. Dispersed limit prices (i.e., lower elasticity) lead to lower first-day returns and higher aftermarket price volatility. This finding is consistent with limit prices containing information about the investors' perception of the value of the shares.

Not all issues in our data set are IPOs. Some of the issues are seasoned equity offerings (SEOs), yet the investment bank built a book because the outstanding equity was illiquid or was small relative to the size of the new issue. Despite the existence of a market price, we find that the investment banker deviates from it on the basis of the information in the book, especially the limit prices. We also detect a tendency of the aftermarket price to return towards the premarket price.

Other papers also study the relation between information available at the time the offer price is chosen and aftermarket returns. Hanley (1993) examines the relation between the IPO price and the preliminary price range and finds that issues priced near the maximum of the range perform better in the aftermarket. Similarly, Loughran and Ritter (2002) document that most IPO underpricing comes from the minority of issues in which the offer price is revised upwards relative to the initial range. One advantage of our paper is that we use detailed information about demand for shares. Thus, we can control for the underwriter's information when he chooses the issue price.

The paper proceeds as follows. Section I describes the data and the bookbuilding procedure. Section II studies the choice of the issue price. Section III considers how public and private information are incorporated into the book and the issue price. In Section IV, we discuss the aftermarket price behavior. Section V studies SEOs. Section VI concludes.

I. Description of the Bookbuilding Procedure and Summary Statistics

We analyze the book of a major European investment bank for 63 international equity issues between 1995 and 1999.[1] The bank has a prominent Wall Street presence and regularly competes with the largest American banks. The issuing companies come from 24 different countries and from many different industries. Of these issues, 37 are IPOs and 26 are SEOs. Twenty of the 63 issues are privatizations (both IPOs and later tranches). Most of the paper focuses on IPOs, while

[1] This investment bank is the global bookrunner for all issues. In two issues, there is a global cobookrunner, both bulge-bracket firms.

SEOs are discussed in Section V. Table I reports summary statistics for both IPOs and SEOs.

For IPOs, before soliciting bids from investors, the investment banker announces a price range within which he expects to price the issue. This initial range is only indicative and the final issue price may be outside the range. In our sample, the average size of the range is 16 percent, relative to its midpoint. The banker collects bids from institutional investors over a period of approximately two weeks. Immediately after closing the book, the investment bank sets the final issue price. On average, the issue price is 51 percent of the way from the minimum to the maximum of the range.

Our sample includes five IPOs for which the price is set outside of the initial range—four times below the minimum and once above the maximum. The price is set twice at exactly the minimum of the range and 11 times exactly at the maximum of the range. This concentration of issues priced at the extremes of the range (in particular at the maximum of the range) is consistent with Ljungqvist, Jenkinson, and Wilhelm's (2003) result for a large set of international equity offerings.[2] The fact that the investment banker is more willing to price an issue below the range minimum than above the maximum is consistent with Lowry and Schwert's (2002) finding that underwriters appear to incorporate negative information more fully into the offer price than positive information.

For SEOs, no initial price range is given, since the market price already serves as an indication. On average, the SEOs in our sample are priced at a 2.2 percent discount relative to the premarket price (the last market price before the issue price is set).

Bids submitted during bookbuilding can be denominated either in shares or in currency units (e.g., $5 million worth of shares). The book distinguishes between three types of bids. A "strike bid" is a bid for a specified number of shares or amount of money regardless of the issue price. In a "limit bid," the bidder specifies the maximum price that he is willing to pay for the shares (i.e., a limit price). In a "step bid," the bidder submits a demand schedule as a step function. In other words, a step bid is a combination of limit bids.

Our data set comprises all the information in the book, including each bid submitted, the identity of the bidder, the number of shares (or dollar amount) requested, and any limit price. The book also shows the date when the bid was entered and any subsequent revision (or cancellation) of the bid.

In our sample, there are 7,905 different bidders from 65 different countries and territories. The largest number of bidders come from the United States and the United Kingdom. A total of 318 bidders (4 percent) participate in at least 10 issues and submit 37.4 percent of all bids. A total of 1,500 bidders (19 percent) participate in at least three issues and submit 67.1 percent of all bids.

[2] According to the bank that supplied our data, there is still an aversion in Europe to pricing outside the range. Issues priced below the minimum of the range are regarded as an embarrassment, and pricing above the range is resisted by institutional investors, who regard such pricing tactics as taking unfair advantage of their strike bids. However, this tendency is disappearing over time. An American bank that places shares with European investors would face the same difficulties.

Table I

Summary Statistics of Issue and Bid Characteristics

This table reports summary statistics of issue and bid characteristics for the IPOs and SEOs in the sample. All statistics (except *Number of issues* and *Number of privatizations*) are computed across the issues. *Issue price* and *Average limit price* (the quantity-weighted average of all limit prices in an issue) are normalized by the initial price range for IPOs and by the last premarket price for SEOs. *First-day return* is benchmarked relative to the domestic stock market index. *Elasticity* is the elasticity of demand computed from the issue price or the average limit price to a price one percent higher. *Oversubscription* is the total demand for shares divided by the total number of shares issued (including overallotment).

		IPOs	SEOs
Number of issues		37	26
Number of privatizations		8	12
Range size (relative to midpoint)	*mean*	16.3%	N/A
	median	14.8%	N/A
Issue price (normalized)	*mean*	0.51	− 2.17%
	median	0.67	− 1.92%
	max	1.50	0.26%
	min	− 1.20 (relative to range)	− 7.24% (relative to premarket price)
First-day return (benchmarked)	*mean*	7.57%	3.27%
	median	4.29%	3.73%
Number of bids per issue	*mean*	411	236
	median	375	172
Number of limit & step bids per issue	*mean*	62	55
	median	29	41
Average limit price (normalized)	*mean*	0.49	− 1.48%
	median	0.49	− 1.61%
	max	1.55	2.73%
	min	− 0.92 (relative to range)	− 9.57% (relative to premarket price)
Standard deviation of limit prices (normalized)	*mean*	0.75%	0.36%
	median	0.48% (relative to range midpoint)	0.27% (relative to premarket price)
Elasticity			
at issue price	*mean*	12.8	17.5
	median	3.6	13.7
at average limit price	*mean*	6.4	16.8
	median	1.0	10.2
Oversubscription			
at issue price	*mean*	9.1	3.1
	median	4.5	2.8
	max	62.3	7.9
	min	1.2	1.3
all bids	*mean*	9.9	3.4
	median	5.4	3.1
strike bids	*mean*	8.0	2.1
	median	3.0	2.1
limit and step bids	*mean*	1.9	1.3
	median	1.4	1.2

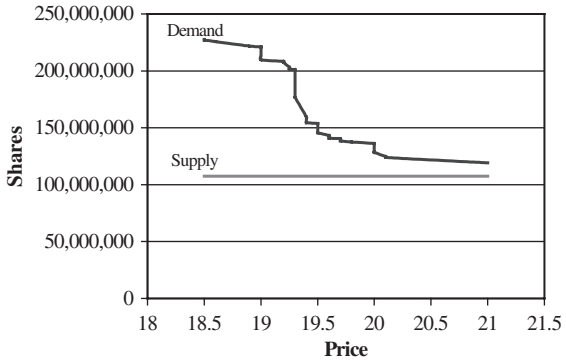

Figure 1. Example of supply and demand curves. This figure shows the demand and supply curves for a single issue in our sample. In this example, demand is greater than supply over the entire price range.

Most bids are strike bids, but 17.5 percent are limit or step bids. This percentage varies considerably across issues, and, in fact, in two of the IPOs, there are no limit bids at all. We summarize the information contained in limit and step bids by computing the average limit price, where the average is weighted by the quantities demanded at each limit price.[3]

Bidders can submit bids at any time while the book is open. They can also freely revise their bids: They can change quantities or limit prices, change bids from limit to strike (and vice versa), or cancel them. (Overall, 6.4 percent of bids are ultimately cancelled.) On average, 56 percent of all demand arrives in the three days prior to the closing of the book. In IPOs, the average limit price changes by 2.8 percent, on average, over the final three days of the book. If an issue becomes very "hot" (i.e., the demand for shares increases dramatically), limit and step bids tend to be converted to strike bids.

After collecting the bids, the underwriter aggregates them into a demand curve and chooses the issue price. The issue price is not set at the point where aggregate demand equals supply. Rather, the underwriter chooses a price at his discretion that is below the market-clearing price. Figure 1 is an example of the demand curve for one issue and shows that demand can even be above the supply over the entire range.[4]

Issues differ substantially in terms of demand; some issues are barely subscribed, and others are heavily oversubscribed. Table I shows that the average oversubscription (defined as total demand at the issue price divided by total supply) is 9.1 for IPOs and 3.1 for SEOs. Some IPOs are heavily oversubscribed—up to 62 times the number of shares offered.

[3] For step bids, the weights are the additional quantities demanded at each limit price.

[4] We define supply as all shares allocated, including those backed by the overallotment option.

Because demand depends on the price at which it is computed, the underwriter is effectively choosing the oversubscription when he sets the issue price. Since oversubscription at the issue price is endogenous, we also consider measures of oversubscription at other points along the demand curve. We compute the oversubscription at a price just above the highest submitted limit price, which captures the demand due to strike bids alone. We also compute the oversubscription at the lowest limit price, which captures the demand from all bids. The difference between these two measures is the demand from limit and step bids.[5] Table I presents summary statistics of the different oversubscription measures.

We also consider demand elasticity, which is related to the dispersion of the limit prices. If there are many limit and step bids, and all the limit prices are close to each other, then the demand is very elastic. In Table I, we report average elasticity at both the issue price and the average limit price.[6] The average elasticity is higher for SEOs than for IPOs, reflecting the greater degree of uncertainty surrounding IPOs. When measured at the average limit price, the average elasticities are 6.4 for IPOs and 16.8 for SEOs, the difference being statistically significant. When measured at the issue price, the difference between IPOs and SEOs is smaller and not statistically significant.

After the underwriter sets the price and allocates the shares, aftermarket trading begins. In our sample, the average first-day return is 7.6 percent for IPOs and 3.3 percent for SEOs (benchmarked against the domestic stock market).[7]

Since our data come from just one European bank, we address the representativeness of the sample, relative to American banks. In private conversation, a number of practitioners described the bank that supplied our data as competing with major American banks and having a bookbuilding process very similar to that of American banks. Our bank also has a significant presence in the United States. However, we still want to compare the characteristics of our bank to large American banks.

We compare our bank to the American and non-American banks that underwrite IPOs outside the United States and whose characteristics are described in Ljungqvist et al. (2003). The bank that supplied us with our bookbuilding data is one of the very top underwriters (by market share) on their list. Ljungqvist et al. document some important differences between large American banks and non-American banks. Issues underwritten by American banks are much more likely to be marketed in the United States and almost always use bookbuilding. In addition, American banks are rarely in junior syndicate positions. On all of these measures, the bank in our study is very similar to American banks and not similar to non-American banks.

[5] The difference between the two measures of oversubscription also includes the downward slope due to bids denominated in currency units. However, this effect is small.

[6] We measure elasticity over an interval from the issue price (or the average limit price) to a price which is one percent higher.

[7] The first-day return for SEOs is relatively high, possibly reflecting the relative illiquidity of these shares before the offering.

Ljungqvist et al. (2003) find that issues in which the lead underwriter is an American bank have significantly reduced underpricing compared to other issues, particularly when marketed to U.S. investors. We find that the underpricing of issues underwritten by our bank is not statistically different from that of issues underwritten by American banks, and is significantly reduced relative to non-American banks, particularly when marketed in the United States.[8] This result is consistent with the use of a more sophisticated form of bookbuilding, which is more effective in reducing underpricing.

II. Determining the Issue Price

In this section, we study how the investors' bids are used by the underwriter when choosing the issue price. If the investment banker builds the book only for the purpose of managing the distribution of shares, then the demand in the book should not influence the issue price. In contrast, Benveniste and Spindt (1989) and Spatt and Srivastava (1991) argue that bids provide information that is used to price the issue more accurately. As compensation for providing this information, the investment banker underprices the issue and allocates more shares to the investors who revealed information during bookbuilding. Thus, bookbuilding is in the interest of the issuer, since it can reduce the uncertainty and hence the (adverse selection related) underpricing. If investment banks rely on bids for pricing the issue, we can interpret bookbuilding as information acquisition rather than distribution management.

When we study the effect of the information in the order book on the issue price, we must control for the information available prior to the bookbuilding process. We do so by normalizing the IPO price relative to the initial indicative price range, so that an issue priced at the minimum of the range is set to zero and an issue priced at the maximum of the range is set to one.[9] Formally, the normalized issue price is given by $(P_I - P_{min})/(P_{max} - P_{min})$, where P_I is the issue price and P_{max} and P_{min} are the maximum and minimum of the initial price range. The normalized issue price is below zero or above one when the issue is priced outside the initial range. This normalization assumes that, prior to bookbuilding, the expected issue price is equal to the midpoint of the range. The fact that the average normalized issue price is almost exactly at the midpoint of the range supports the use of the midpoint as a proxy for the prebookbuilding expectation of the issue price.

Moreover, this normalization also adjusts for the size of the range. When the issue price differs by a fixed amount from the midpoint, we consider it a large

[8] To conduct this test, we follow the two-stage methodology of Model 5 in Table 8 of Ljungqvist et al. (2003). We find that the coefficients of (our bank $\times$ marketed in the United States) and (our bank $\times$ not marketed in the United States) are not significantly different from the coefficient of (American bank $\times$ marketed in the United States) and (American bank $\times$ not marketed in the United States), respectively. We are grateful to Alexander Ljungqvist for conducting this test for us on their data.

[9] On the few occasions in which the investment banker revises the price range, we use the initial range to capture the ex ante uncertainty.

adjustment if the range is narrow, but a small adjustment if the range is wide. This procedure implicitly assumes that a wide range reflects a high degree of uncertainty prior to bookbuilding.

The information in the book is mainly contained in the quantities demanded by investors and their limit prices. We capture the quantity demanded with (the logarithm of one plus) oversubscription. We focus primarily on oversubscription measured at the lowest limit price, capturing the demand from all bids. We also measure oversubscription corresponding to only strike bids, and oversubscription corresponding to only limit and step bids. We characterize limit prices by their quantity-weighted average, normalized relative to the initial range. While oversubscription captures the total demand for the stock, the average limit price captures the maximum that price-sensitive investors are willing to pay. We also look at the consensus among bidders as captured by the elasticity of demand.

Table II presents the results of the analysis on the relation between the normalized IPO price and the bids in the book. Regression 1 shows that the average limit price alone explains 81.5 percent of the cross-sectional variation in the sample of normalized IPO prices. The coefficient of the average limit price is positive and statistically different from zero (p-value = 0.000), but not from one (p-value = 0.154). Thus, the investment banker adjusts the IPO price one for one with the average limit price.

The coefficients of the oversubscription variable in Regressions 2 and 3 are also positive and statistically significant. However, the lower R-squared for Regression 2 (37.5 percent) implies that the average limit price, although it comes from a minority of bidders, has far more explanatory power than does oversubscription.[10]

The relative importance of oversubscription and average limit price is also reflected in the size of the coefficients. For example, using the coefficients of Regression 3 and assuming an initial price range of \$50 to \$60, if the average limit price increases by \$1, the issue price also increases by approximately \$1. In contrast, the demand for shares would have to increase by at least 68 percent to increase the issue price by the same amount. The logarithm of (one plus) oversubscription would have to change by 3.4 standard deviations to have the same effect as a one standard deviation change in the normalized average limit price.

The importance of both average limit price and oversubscription for choosing the issue price demonstrates the role of bookbuilding as an information extraction mechanism. These bids account for most of the cross-sectional variation in offer prices (relative to the range), suggesting that any initial information gathered by the investment bank is already summarized in the preliminary price range. Building on the preliminary information, investors reveal their own views about the value of the firm relative to the range via their bids.

[10] The statistically significant negative intercepts in Table II should not be interpreted as evidence of underpricing. Since oversubscription is always positive, the negative intercept merely offsets it. When we repeat the regressions with demeaned oversubscription, the intercept is no longer statistically different from zero.

Table II

The Choice of the Issue Price (IPOs)

This table reports regression coefficients for various model specifications. Heteroskedasticity-adjusted *t*-statistics, using White's (1980) variance–covariance matrix, are in parentheses. Except where otherwise specified, the dependent variable is the issue price normalized by the initial price range. *Average limit price* is the quantity-weighted average of all limit prices and is normalized by the initial price range. *Oversubscription* is the logarithm of 1 + total demand/supply of shares, with demand measured at various prices. *Elasticity* is the elasticity of the logarithm of demand computed from the average limit price to a price one percent higher. *Range size* is measured relative to its midpoint. In Regression 10, the dependent variable is the issue price divided by the range midpoint, and the average limit price is normalized by the range midpoint. In Regression 11, the dependent variable is the absolute value of (issue price/average limit price − 1).

Dependent Variable (Regs 1 to 9): Issue Price (Normalized by Initial Price Range)								Excluding Range Endpoints	Only Range Interior	Dependent Variable: Issue Price Normalized by Midpoint	Dependent Variable: Absolute Value of (Issue Price/ Avg Lim Price − 1)
	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	Reg 6	Reg 7	Reg 8	Reg 9	Reg 10	Reg 11
Intercept	−0.06	−0.31	−0.34	−0.24	−0.12	−0.25	−0.35	−0.30	−0.22	−0.35	0.04
	(−0.9)	(−1.3)	(−4.0)	(−3.6)	(−1.1)	(−1.8)	(−4.0)	(−3.5)	(−3.5)	(−4.3)	(1.9)
Average limit price	1.12		0.96	0.97	1.10	0.93		1.05	0.90	0.91	
	(13.3)		(11.0)	(10.2)	(13.0)	(10.1)		(13.3)	(6.7)	(12.0)	
Oversubscription		0.41	0.18			0.19	0.19	0.11	0.12	0.19	−0.01
(all bids)		(4.5)	(4.0)			(4.1)	(4.0)	(3.9)	(3.1)	(4.5)	(−1.0)
Oversubscription				0.15							
(strike bids)				(3.9)							
Oversubscription					0.07						
(limit and step bids)					(0.8)						
Elasticity						0.01					−0.01
						(0.4)					(−2.4)
Range size						−0.68					0.07
						(−1.3)					(0.8)
Average limit price							0.92				
(privatizations only)							(7.8)				
Average limit price							0.97				
(nonprivatizations only)							(10.3)				
Adjusted *R*-squared	81.5%	37.5%	87.3%	87.4%	81.3%	86.9%	87.0%	93.7%	81.9%	88.8%	2.2%
N	35	37	35	35	35	35	35	23	18	35	35

The greater influence of the average limit price on issue prices is consistent with Cornelli and Goldreich (2001), who show that allocations favor investors who submit limit and step bids relative to investors submitting strike bids. They argue that the allocation is compensation for the additional information provided by limit bids relative to strike bids. As we have shown, limit bids do provide most of the information. Additional information gleaned from oversubscription helps refine the issue price.

Regressions 4 and 5 illustrate robustness to alternative measures of oversubscription. Oversubscription due to strike bids alone has a statistically significant influence on the issue price.[11] Oversubscription due to limit and step bids alone is the only measure of oversubscription that is not statistically significant. If we interpret limit prices as information about value, then the total quantity of shares demanded by limit bidders may indicate how many bidders are informed, rather than the extent of their demand for shares.

Regression 6 includes the elasticity of demand as an explanatory variable. A positive coefficient would suggest that the investment banker sets a more conservative price when there is less consensus (i.e., lower elasticity) among the bidders. Rather than measuring elasticity at the issue price, which is endogenous, we measure elasticity at the average limit price. (Since we expect elasticity to enter in a nonlinear way, we use the elasticity of the logarithm of the demand.) We find that the coefficient of elasticity is not significantly different from zero.

Regression 6 also includes the size of the range as a percentage of its midpoint to capture ex ante uncertainty about the value of the stock. If this uncertainty is not resolved, the banker might price the issue more conservatively relative to the range. On the other hand, he may have already set the range lower because of this uncertainty and will not further adjust the issue price. The results of the regression show that the effect of the range size on the normalized IPO price is negative but not statistically significant.[12]

Since eight of the IPOs in our data set are privatizations, in Regression 7 we consider separately the effect of the average limit price for privatizations and nonprivatizations. The common argument that a government privatizing a company has different objectives than private issuers does not apply here, since the bidders in the book are primarily foreign institutional investors. On the other hand, since an unsuccessful privatization may hurt its political reputation, the government may price the issue more conservatively. The coefficients of the average limit price are significantly positive for both privatizations and nonprivatizations and are not significantly different from each other, suggesting that governments do not set the offer price differently than private issuers.

The concentration of issue prices at the endpoints of the initial range suggests reluctance among bankers to price outside the range. If this (perhaps

[11] We also find positive coefficients on oversubscription measured at the average limit price and at the midpoint of the range. We do not present the results, since they are very similar to those in Regression 3.

[12] Since we use range size in the normalization of the dependent variable, we repeat the regression with the issue price normalized relative to the midpoint of the range as the dependent variable. The coefficient remains insignificant.

self-imposed) constraint reflects deviation from the normal pricing rule, the explanatory power of the regression model should rise with the exclusion of such cases. Regression 8 indicates this to be the case. Regression 9 further excludes issues priced outside the range. The explanatory power of the model declines with this specification. Taken together, these results suggest that pricing at the endpoints reflects deviation from the normal pricing rule.

Since we interpret the high R-squared in Table II as evidence that, given a price range, the decision of which price to choose in that range is almost completely driven by the opinion of the bidders, we now consider whether the R-squared is driven by the normalization of the issue price. The correlation between the range size and the absolute value of the percentage difference between the issue price and the range midpoint is 0.33 (p-value $= 0.044$). Once normalized, there is no longer a statistically significant correlation, suggesting that the normalization correctly adjusts for the uncertainty before the offering.[13] An alternative normalization uses the percentage difference between the issue price and the range midpoint. This alternative normalization adjusts for the expected price level, but not for the uncertainty prior to bookbuilding. Regression 10 indicates that our results are robust to this alternative normalization.[14]

Although we found that neither the elasticity nor the initial range size significantly influence the issue price (Regression 6), they may still affect the degree to which the investment banker relies on the average limit price. For example, the banker may be more influenced by limit prices that are close together. In Regression 11, the dependent variable is the absolute value of the percentage difference between the issue price and the average limit price. The independent variables include both elasticity and range size. We find that the coefficient of the elasticity is negative and statistically different from zero, suggesting that the investment banker relies more on the limit bids when there is consensus (i.e., when there is less uncertainty remaining at the end of the bookbuilding process). The coefficient of range size remains statistically insignificant, suggesting that this proxy for uncertainty at the beginning of bookbuilding does not influence the extent to which the investment banker relies on the limit bids.

In sum, Table II suggests that issue prices are influenced by information contained in limit prices and oversubscription. In Table III, we explore whether the bank learns more from some key bidders than from others. We distinguish bidders on several dimensions. First, we define a bid as large (small) if the quantity

[13] The normalization may exaggerate the results if there is a negative correlation between the issue price relative to the midpoint and the size of the range. We find a negative correlation, but it is not statistically significant.

[14] As an additional check, we also normalize the issue price by using a market-adjusted range that controls for marketwide movements while the book is open. Thus, we ensure that the observed relation is not driven by market movements that affect the limit prices and the issue price in the same direction. If the initial range is set at $[P_{min}, P_{max}]$ and over the life of the book the stock market rises by a rate r, then our expectations of both the issue price and the limit prices should go up by r, inducing correlation. To correct for this, we define the benchmarked range as $[(1+r)P_{min}, (1+r)P_{max}]$, where r is the total return on the domestic stock market from the date of the first bid in the book until the pricing date. The results are similar to those in Table II.

Table III

Influence of Different Types of Bidders (IPOs)

This table reports regression coefficients (and heteroskedasticity-adjusted *t*-statistics in parentheses) for various model specifications. The dependent variable is the issue price normalized by the initial price range. *Average limit price* is the quantity-weighted average of all limit prices and is normalized by the initial price range. *Oversubscription* is the logarithm of 1 + total demand/supply of shares. Large (small) bids are bids with a quantity above (below) the median in an issue. Frequent (infrequent) bidders are bidders who participate in at least (fewer than) three issues. Favored bids are bids that are awarded more shares (as a percentage of the bid quantity) than the median bid. The symbols †††,†† denote *pairs of coefficients* that are significantly different from each other at the one and five percent confidence levels, respectively.

Panel A: Average Limit Price of Different Types of Bidders

Dependent Variable: Issue Price (Normalized by Initial Price Range)			
	Reg 1	Reg 2	Reg 3
Intercept	− 0.32	− 0.26	− 0.41
	(− 4.7)	(− 3.1)	(− 5.1)
Oversubscription	0.18	0.15	0.18
(all bids)	(4.3)	(2.6)	(4.3)
Average limit price	1.14†††		
(large bids)	(6.2)		
Average limit price	− 0.20†††		
(small bids)	(− 1.2)		
Average limit price		1.25†††	
(frequent bidders)		(4.8)	
Average limit price		− 0.29†††	
(infrequent bidders)		(− 1.3)	
Average limit price			1.15††
(favored bids)			(9.0)
Average limit price			− 0.23††
(nonfavored bids)			(− 1.9)
Adjusted *R*-squared	86.7%	86.0%	89.1%
N	34	29	32

Panel B: Oversubscription of Different Types of Bidders

Dependent Variable: Issue Price (Normalized by Initial Price Range)			
	Reg 4	Reg 5	Reg 6
Intercept	− 0.38	− 0.29	− 0.27
	(− 3.3)	(− 3.7)	(− 3.5)
Average limit price	0.96	0.98	0.93
(all bids)	(11.3)	(10.9)	(11.1)
Oversubscription	0.24		
(large bids)	(2.7)		
Oversubscription	− 0.13		
(small bids)	(− 0.7)		
Oversubscription		0.15	
(frequent bidders)		(2.8)	
Oversubscription		0.05	
(infrequent bidders)		(0.5)	
Oversubscription			0.01
(favored bids)			(0.2)
Oversubscription			0.25
(nonfavored bids)			(2.9)
Adjusted *R*-squared	87.0%	86.3%	84.9%
N	35	35	35

of shares demanded is above (below) the median bid quantity in that issue. We also distinguish between bids from frequent and infrequent investors. We define a frequent investor as one who takes part in at least three issues.

In Panel A, Regression 1 indicates that there is a statistically significant relation between the issue price and the average limit price of large bids, but not of small bids. Similarly, Regression 2 shows that limit prices from bidders who frequently participate in the offerings have explanatory power, but limit prices from infrequent investors do not.[15] This suggests that the underwriter perceives some bidders as more reliable than others, either because of a long relationship with them or because a large bid signifies a stronger commitment. Alternatively, as some recent theories argue, the underwriter favors frequent investors to provide them with an incentive to collect and reveal information (see, e.g., Benveniste and Spindt (1989), Benveniste and Wilhelm (1990), and Sherman (2000)).

Since the price is set so that the issue will be oversubscribed, in general investors will be rationed and will receive fewer shares than they demand. As Benveniste and Spindt (1989) argue, the rationing allows the banker to compensate informed bidders through more favorable allocations. We attempt to detect this in the data by identifying favored bidders, defined as those who are awarded a larger fraction of their demand than the median bidder. Consistent with the Benveniste and Spindt argument, Regression 3 shows that the average limit price from favored bids has substantial explanatory power, but the average limit price from nonfavored bids does not.

Finally, in Panel B of Table III, we divide oversubscription among the different bidder categories. Oversubscription from large bids and frequent bidders is positive and significant, but oversubscription from small bids and infrequent bidders is not significant (although the two coefficients are not significantly different from each other).[16] However, when we compare favored and nonfavored bidders, only the oversubscription from nonfavored bids is significant (although these two coefficients are also not significantly different from each other). This result is similar to our finding that oversubscription due to limit and step bids is not significant. If favored bidders are the informed ones, then this result might suggest that, although the specific information in each bid influences the pricing, the number of informed bidders does not.

III. Public and Private Information

In this section, we look at the nature of information contained in the bids and how public and private information from investors are incorporated into the issue price.

[15] The number of observations varies in these regressions, since observations are lost when there are no limit bids from a particular subset of bidders in some issues. The loss of observations is also the reason why we do not consider the intersections of these subsets.

[16] In press coverage regarding some issues, the investment bank reported, as a positive note, that the demand was composed of large-size bids.

Since bookbuilding can take up to three weeks, we first distinguish between early and late bids to determine their relative importance. As information evolves over the bookbuilding period (e.g., because of marketwide stock price movements), late bids should incorporate more information (both public and private) than early bids. In Table IV, we divide the book into two periods: (1) the "early" period, which we define as the period from the beginning of bookbuilding until three days before its conclusion, and (2) the "late" period, consisting of the final three days.

We compute the average limit price from bids in each period and the change in the average limit price between the two periods. In Regression 1, the coefficients of both the average limit price from early bids and the change in the average limit price are statistically significant. Thus, early limit and step bids already contain relevant information that is used in pricing the issue, and further information arrives in the last three days. However, Regression 2 shows that when we introduce the average limit price from late bids, the information from the early period is subsumed by the later bids. When oversubscription is divided between the early and late periods (Regression 3), oversubscription from late bids is statistically

Table IV

The Evolution of the Book: How Early Bids Influence the IPO Price

This table reports regression coefficients (and heteroskedasticity-adjusted *t*-statistics in parentheses) for various model specifications. The dependent variable is the issue price normalized by the initial price range. *Average limit price* is the quantity-weighted average of all limit prices and is normalized by the initial price range. *Oversubscription* is the logarithm of 1 + total demand/supply of shares. Early bids are bids received at least three days prior to the closing of the book. Late bids are bids received in the last three days. Δ*Avg limit price* is the difference between the average limit price in the final book and the average limit price from early bids.

Dependent Variable: Issue Price (Normalized by Initial Price Range)	Reg 1	Reg 2	Reg 3
Intercept	− 0.25	− 0.23	− 0.28
	(− 3.1)	(− 3.0)	(− 3.9)
Average limit price			0.96
(all bids)			(10.7)
Average limit price	0.90	− 0.64	
(early bids)	(10.3)	(− 2.6)	
Average limit price		1.57	
(late bids)		(6.4)	
ΔAvg limit price	1.32		
	(5.5)		
Oversubscription	0.14	0.14	
(all bids)	(2.6)	(3.5)	
Oversubscription			0.07
(early bids)			(1.37)
Oversubscription			0.14
(late bids)			(3.06)
Adjusted *R*-squared	87.0%	87.9%	86.2%
N	34	33	34

related to the issue price, but the coefficient of early oversubscription, although positive, is statistically insignificant.

The evidence in Table IV suggests that information arrives from the start of bookbuilding and is refined over time. We might wonder whether the additional information that arrives through late bids is public or private. Some recent papers (Loughran and Ritter (2002) and Lowry and Schwert (2002)) find that the issue price and the first-day aftermarket returns are affected by information that is publicly available at the time of bookbuilding, such as market index returns before or during bookbuilding, industry, and other characteristics of the issuing firm. The relation between public information and aftermarket returns implies that the issue price only partially adjusts to public information. This would contradict the view that bookbuilding is designed to collect information from the bidders, since investors should not be compensated for public information.

To understand the partial adjustment to public information, we examine whether this information affects the issue price directly or if it is filtered through the bids. For example, if the investment banker observes a positive stock market return, will he raise the issue price as a result, or will he do so only if investors bid more aggressively? If he relies on the reaction of investors to public information, then it could be argued that the bidders should be compensated for conveying their interpretation.

The first type of public information that we consider is the domestic stock market index return during the bookbuilding period.[17] In Table V, we look at how the market return affects bids and the issue price. To make the issue price and average limit price comparable to the market return, we normalize them relative to the midpoint of the range so that they are all measured in percentage points. (We also conduct the analysis by normalizing issue price and average limit price relative to the range, with similar results.)

Regression 1 shows that the change in the average limit price is positively and statistically related to the market index return: When the market moves upwards, late bidders bid more aggressively than early bidders. However, the standard error is high and the adjusted R-squared is low, so the market returns have little explanatory power on the change in the average limit price: Looking directly at the bids increases the accuracy of the information.

In Regression 2, we regress the issue price on the average limit price from early bids, the market return, and the residuals from Regression 1. These residuals capture the portion of the change in the average limit price that is not due to the market index return. We find that both the market return and the residuals have positive and statistically significant coefficients. Thus, the issue price is influenced by the publicly available market return as well as an additional component in the bids (possibly private information) that is unrelated to the market return.

Since Regressions 1 and 2 show that the market return affects both the bids and the issue price, we want to establish whether the investment banker reacts to the market return directly, or only because of its effect on the bids. Therefore,

[17] We also look at market returns over different time intervals before the start of the bookbuilding, but they are not significantly related to the issue price.

Table V

Public and Private Information—Market Index Return

This table reports coefficients (and heteroskedasticity-adjusted *t*-statistics in parentheses) for regressions related to the market index return during the bookbuilding period for IPOs. *Market return* is the return on the domestic stock market index over the bookbuilding period. *Average limit price* is the quantity-weighted average of all limit prices. The issue price and average limit price are normalized by the midpoint of the range. Early bids are bids submitted more than three days before the close of the book. Δ*Avg limit price* is the difference between the average limit price in the final book and the average limit price from early bids. In Regression 2, the independent variable *Portion of* Δ*Avg limit price not explained by Market return* is the residual from Regression 1. In Regression 4, the dependent variable *Portion of Issue price not explained by Avg limit price* is the residual from Regression 3. The coefficients of the intercepts are not reported.

	Reg 1	Reg 2	Reg 3	Reg 4
Dependent Variables:	Δ*Avg Limit Price*	*Issue Price (normalized by range midpoint)*	*Issue Price (normalized by range midpoint)*	*Portion of Issue Price Not Explained by Avg Limit Price*
Independent Variables:	*Market return* 0.190 (2.24)	*Average limit price (early bids)* 0.977 (13.89)	*Average limit price (early bids)* 0.982 (13.84)	*Market return* 0.077 (0.84)
		Market return 0.372 (4.03)	*Δ Avg limit price* 1.553 (8.71)	
		Portion of Δ Avg limit price not explained by Market return 1.533 (8.52)		
	Adjusted R-squared = 1.7% $N = 34$	Adjusted R-squared = 82.3% $N = 34$	Adjusted R-squared = 82.7% $N = 34$	Adjusted R-squared = − 2.2% $N = 34$

in Regression 3, we first regress the issue price on the average limit price from early bids and the change in the average limit price. The residuals are the component of the issue price that is not due to the information conveyed through limit prices. In Regression 4, we find no statistically significant relation between these residuals and the market index return, suggesting that the market return affects the offer price only as filtered through the bids.

In Table VI, we look at other types of public information. Lowry and Schwert (2002) find that certain firm characteristics affect the offer price. We examine the effect of these characteristics in a manner similar to the one above for market index returns.

We first look at whether there is an industry effect by constructing a dummy which takes a value of one if the firm is in a high-technology industry. In Regression 1, we find a statistically significant and positive relation between the issue price and the high-tech industry dummy. In Regressions 2 and 3, we see that this industry dummy affects the bids as well, since both average limit price and oversubscription are significantly higher when the issuing firm is a high-tech company. Again, we want to find out whether this firm characteristic is used directly by the underwriter or only as filtered through the bids. To capture the portion of the issue price that is not explained by limit prices and oversubscription, we use the residuals from Regression 10 in Table II (which regresses the issue price on the average limit price and oversubscription). We regress these residuals on the high-tech dummy (Regression 4) and, surprisingly, we find that the coefficient is negative and statistically significant. This suggests that when pricing a high-tech firm, the underwriter actually sets a lower price, conditional on the bids. The reason for this lower pricing may be because high-tech firms are characterized by more uncertainty, and either the investment banker wants to be more conservative in light of the extra risk or the opinion of the bidders is more valuable (and thus they require a larger compensation).

We also look at the size of the firm, as captured by (the logarithm of) sales.[18] In Regression 5, we find that the size of the firm is statistically significant and negatively related to the issue price. The size of the firm also affects the average limit price (Regression 6) but not the oversubscription (Regression 7). In Regression 8, we regress the portion of the issue price not explained by limit prices and oversubscription (captured by the residuals of Regression 10 in Table II) on firm size. The coefficient is not statistically significant, suggesting that the underwriter uses this information only to the extent that it is conveyed through the bids.[19]

Finally, we consider information spillovers. Benveniste, Busaba, and Wilhelm (2002) argue that when a firm goes public, it produces information that is valuable

[18] We also consider total assets, book-to-market, and expected IPO proceeds, but we do not find them to be significantly related to the issue price.

[19] Although we do not report the results, we also consider the market where the IPO is listed. Among the major exchanges we only find a (negative) significant effect on issue prices for the London Stock Exchange (including SEAQ). Moreover, the average limit price and oversubscription are not significantly related to this variable; thus, the underwriter seems to price issues on the London Stock Exchange less aggressively, relative to the book. We do not find a significant difference for NYSE, Nasdaq, or Hong Kong.

TableVI

Public and Private Information—Firm Characteristics

This table reports coefficients (and heteroskedasticity-adjusted *t*-statistics in parentheses) for regressions related to the effect of firm characteristics, including *Industry, Size*, and *Industry IPO activity* on the issue price and on the bids. *High tech* is a dummy equal to one for issuers in a high-tech industry. *Size* is the logarithm of annual sales. *Industry IPO activity* is the number of worldwide IPOs in the industry of the issuer in the current month divided by the average number of monthly IPOs in the industry. The issue price and the average limit price are normalized by the midpoint of the range. *Oversubscription* is the logarithm of 1 + total demand/supply of shares. The dependent variable *Portion of Issue price not explained by the limit prices and Oversubscription* is the residual from Regression 10 of Table II. The coefficients of the intercepts are not reported.

Dependent Variables:	Issue Price (Normalized by Range Midpoint)	Average Limit Price	Oversubscription	Portion of Issue Price Not Explained by the Limit Prices and Oversubscription
	Reg 1	Reg 2	Reg 3	Reg 4
Independent Variable:	High tech	High tech	High tech	High tech
	0.084	0.069	1.073	0.032
	(3.45)	(2.76)	(2.68)	(4.03)
	Adj R-sq. = 5.9%	Adj R-sq. = 4.5%	Adj R-sq. = 14.7%	Adj R-sq. = 18.2%
	N = 37	N = 35	N = 37	N = 35
	Reg 5	Reg 6	Reg 7	Reg 8
Independent Variable:	Size	Size	Size	Size
	− 0.011	− 0.008	− 0.064	0.198
	(− 2.19)	(− 2.01)	(− 0.92)	(1.16)
	Adj R-sq. = 3.6%	Adj R-sq. = 1.3%	Adj R-sq. = − 0.3%	Adj R-sq. = 3.6%
	N = 36	N = 34	N = 36	N = 37
	Reg 9	Reg 10	Reg 11	Reg 12
Independent Variable:	Industry IPO activity	Industry IPO activity	Industry IPO activity	Industry IPO activity
	0.041	0.032	0.198	0.005
	(4.60)	(4.03)	(1.16)	(1.40)
	Adj R-sq. = 20.0%	Adj R-sq. = 18.2%	Adj R-sq. = 3.6%	Adj R-sq. = 0.2%
	N = 37	N = 35	N = 37	N = 35

to other firms in the same industry that also may go public. To compensate the first firm that goes public in an industry, the underwriter bundles issues together, distributing the cost of information acquisition among all firms. Consistent with this theory, Benveniste, Ljungqvist, Wilhelm, and Yu (2003) find that when more firms in an industry go public at the same time, the issuer learns more during the bookbuilding process (as captured by the revision in the price relative to the initial range). To look for this phenomenon, for each IPO in our sample we count the number of IPOs that occur worldwide in the same month and industry (as reported by Datastream). We divide this number by the average number of IPOs per month in the industry, to obtain a measure of IPO activity relative to the normal level.

Regression 9 shows that the issue price is positively and significantly related to the IPO activity in the industry. Consistent with Benveniste, Busaba, and Wilhelm (2002), the larger the number of IPOs in the industry, the higher the information spillovers and the more learning that takes place during bookbuilding. The average limit price, but not the oversubscription, reacts to the volume of IPOs in the industry (Regressions 10 and 11). Moreover, in Regression 12, we see that there is no statistically significant effect of information spillover on the issue price beyond its effect through the bids.

To summarize this section, although we find that certain public information affects the issue price, in most cases it arrives through the bids and not directly. Our interpretation is that the banker must see the reaction of the investors to the public information in order to assess its significance. Thus, the distinction between public and private information is not as clear as one might think.

IV. Information in the Book and Aftermarket Prices

In the previous sections, we found that the investment bank relies on the bids in the book to set the issue price and we interpreted it as evidence that the book contains useful information. It still remains to be seen whether the information in the book correctly values the shares, as reflected in the aftermarket.

In this section, we study the aftermarket prices at the end of the first trading day, benchmarked relative to the index of the domestic stock exchange of the issuing company.[20] We investigate whether the information collected and used by the underwriter is correct and whether there is residual information in the book which is not captured by the issue price.

In Table VII, Regression 1, we start by studying whether the aftermarket return depends on where in the range the price is set. This may happen if, for example, the investment banker is reluctant to set the issue price outside the range, or because incentive compatibility requires a larger rent to compensate investors who

[20] Although we do not present the results, we repeat the regressions in this section with returns over the period from the end of the first day until the end of the first week and of the second week. We do not find any statistically significant results. However, after the first day, price movement in the first month is limited because of underwriter price-stabilization activities (see Ellis, Michaely, and O'Hara (2000) and Aggarwal, Prabhala, and Puri (2002)).

convey a high signal. The coefficient of the (normalized) issue price is positive and statistically significant: Issues priced at the maximum of the range outperform issues at the minimum of the range by about seven percent.[21] This is the partial adjustment phenomenon found by Hanley (1993) and does not depend on the information in the book. It just means that anyone can predict returns by looking at where the issue is priced in the range.

We then show that the book provides additional information that can predict returns. Regression 2 shows that the larger the oversubscription, the higher is the aftermarket return. Note that the issue price relative to the range is no longer statistically significant. Thus, the explanatory power of the issue price relative to the range may be due to the investment banker not fully responding to a high oversubscription when pricing the issue high in the range. Once we control for oversubscription, the effect disappears.

Since we found that the investment banker is reluctant to price the issue above the range, we check whether he underreacts to oversubscription in general, or only when oversubscription suggests an issue price outside of the range. In Regression 3, we only consider issues for which the price was set strictly in the interior of the range. In Regression 4, we consider issues with an oversubscription that is not excessive (below eight). Since the oversubscription coefficient remains positive and statistically significant in both regressions, the explanatory power is not due to "stickiness" at the top of the range, but to a general tendency of the investment banker to underreact to high levels of oversubscription.

There are several possible explanations for this underreaction to oversubscription. First, as suggested by Loughran and Ritter (2002), when oversubscription is high, the underwriter knows that he can set a higher price, but leaves additional money on the table for agency reasons. Second, since bidders who expect to be rationed may exaggerate their demand, the investment banker deflates the excessive demand to counteract the exaggeration, but he overadjusts for this. Finally, since incentive compatibility requires that high signals are compensated more than low signals, this return is a compensation for the information in the demand.

In Regression 5, the coefficient of the percentage difference between the average limit price and the issue price is not statistically significant. The investment banker appears to accurately use the information in the limit prices when pricing the issue.

In Section II, we tested whether the investment bank sets a lower offer price if there is lack of consensus among investors and we found that the coefficient on demand elasticity is not statistically significant. In contrast, in Regressions 6 and 7 of Table VII, we use the elasticity of demand (both at the issue price and at the limit price) as an explanatory variable for aftermarket returns, and we find that the coefficient is positive (and in the case of the elasticity measured at the issue price, statistically significant).[22] A lack of consensus among bidders,

[21] Regression 1 excludes one outlier, which is priced at the maximum of the range and has a first-day return of 70 percent. When we include the outlier, the results are much stronger. To be conservative, we drop that issue from all regressions related to aftermarket returns.

[22] In Section II, we computed the elasticity only at the average limit price, since the elasticity at the issue price would be endogenous. When we study the aftermarket returns, endogeneity is not a problem.

Table VII
Aftermarket Return: IPOs

This table reports regression coefficients (and heteroskedasticity-adjusted *t*-statistics in parentheses) for various model specifications. The dependent variable is the first-day aftermarket return benchmarked relative to the domestic stock market index. *Issue price* is normalized by the initial price range. *Oversubscription* is the logarithm of 1 + total demand/supply of shares. The average limit price is the quantity-weighted average of all limit prices. *Elasticity* is computed from the issue price (or average limit price) to a price one percent higher.

Dependent Variable: First-Day Return (Benchmarked)			Only Range Interior	Only Low Oversubscription			
	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	Reg 6	Reg 7
Intercept	0.02	− 0.06	− 0.05	− 0.08	− 0.05	− 0.10	− 0.09
	(1.5)	(− 2.3)	(− 1.5)	(− 2.0)	(− 1.5)	(− 3.0)	(− 2.9)
Issue price (normalized by initial price range)	0.07	0.02					
	(3.6)	(1.1)					
Oversubscription (all bids)		0.06	0.06	0.08	0.06	0.08	0.07
		(3.4)	(3.4)	(2.4)	(3.4)	(4.6)	(4.5)
Percentage difference between average limit price and issue price					− 0.46		
					(− 1.1)		
Elasticity (at issue price)						0.014	
						(2.4)	
Elasticity (at average limit price)							0.019
							(1.4)
Adjusted *R*-squared	18.7%	32.5%	21.3%	13.5%	36.6%	35.3%	35.9%
N	36	36	19	22	34	36	34

measured by a low elasticity, means that investors have diverse opinions about the value of the shares and this diversity of opinions results in lower returns. This result is consistent with Kandel, Sarig, and Wohl (1999), who find that the demand elasticity in IPO auctions is positively related to aftermarket returns. They argue that elasticity affects the price of the shares for two reasons: first, an elastic demand may reflect more accurate investor information about the payoff of the security and requires a lower risk premium; second, an elastic demand may indicate high future liquidity, which implies lower transaction costs. However, in their IPO auctions, the elasticity is revealed to the market immediately after the auction and a higher aftermarket return can be interpreted as a reaction to the elasticity announcement. In bookbuilding, the demand curve remains confidential, but differences of opinion or differences in valuation are nonetheless translated into lower returns in the aftermarket. This suggests that differences in bids (and especially differences in limit prices) reflect differences of opinion among investors, and that these differences remain after the IPO and affect the share price.

In Table VIII, we further investigate the relevance of the consensus among bidders for aftermarket returns. If limit prices convey information about the value of the shares, then a lack of consensus among limit bidders should imply less predictability of aftermarket prices. In Regressions 1 and 2, we test whether consensus among bidders (measured by elasticity at the issue price and at the average limit price) is related to the unexpected portion of aftermarket returns. We compute the expected returns by using the estimated coefficients from Regression 2 in Table VII (i.e., the expected return conditional on the issue price and oversubscription). The dependent variable is the absolute value of the percentage difference between the actual and expected aftermarket returns. We find that the lower the elasticity, the more the aftermarket returns deviate from the expected returns. In other words, the higher the consensus among investors about the value of the shares, the easier it is to predict the first-day return using the book.

In Table VIII, we also look at whether uncertainty or lack of consensus on the value of the shares affect the aftermarket volatility for the first week, two weeks, and four weeks after the issue. The explanatory variables are range size and elasticity. The range size is a measure of uncertainty at the beginning of bookbuilding, which may or may not be resolved during bookbuilding. A low elasticity corresponds to a high degree of residual uncertainty at the end of bookbuilding. The coefficient of elasticity is negative in all cases, and often statistically significant. The lower the consensus, the higher is the volatility of aftermarket returns. Differences of opinion among limit bidders remain in the market after the shares start trading. This volatility effect occurs despite the price stabilization activities over this period that dampen volatility. The coefficient of the range size is positive and often significant, suggesting that some of the initial uncertainty is still present. These findings justify the common assumption in the empirical IPO literature that aftermarket volatility can serve as a proxy for ex ante risk.

Finally, in Table IX, we test whether demand from certain groups of bidders has more predictive power for aftermarket returns than does demand from other bidders. We find that oversubscription due to large bids and frequent bidders has explanatory power. These are the same types of bids that are relevant in determining the issue price, so the investment banker is correct in assuming that these bidders are informed. The coefficients of oversubscription from small bids and infrequent bidders is not statistically significant. We also find that the oversubscription from late bidders is related to aftermarket returns, but oversubscription from early bidders is not, although the difference between the coefficients is not statistically significant.

V. Seasoned Equity Offerings

While most of the analysis in this paper focuses on IPOs, in this section we study the information content of the book for seasoned equity offerings. The investment banker used bookbuilding for these SEOs despite a readily available premarket price, either because the stock was illiquid or the number of shares

Table VIII

Effect of Uncertainty on Aftermarket Return and Volatility (IPOs)

This table reports regression coefficients (and heteroskedasticity-adjusted *t*-statistics in parentheses) for various model specifications. The dependent variable in Regressions 1 and 2 is the absolute value of the difference between the first-day return and the expected return, where the expected return is computed using the coefficient estimates in Regression 2 in Table VII. The dependent variables in Regressions 3 through 8 are the standard deviations of daily returns in the aftermarket over different time periods. *Elasticity* is computed from the issue price (or average limit price) to a price one percent higher. The average limit price is the quantity-weighted average of all limit prices. *Range size* is measured relative to its midpoint.

Dependent Variables:	Absolute Value of Unexpected First-day Return		Aftermarket Volatility					
			One-week Volatility		Two-week Volatility		Four-week Volatility	
	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	Reg 6	Reg 7	Reg 8
Intercept	0.07	0.07	0.17	0.16	0.20	0.22	0.14	0.12
	(8.1)	(– 3.2)	(1.9)	(1.9)	(3.4)	(3.6)	(1.6)	(1.3)
Elasticity	– 0.01		– 0.03		– 0.02		– 0.03	
(at the issue price)	(– 2.1)		(– 2.7)		(– 1.4)		(– 2.6)	
Elasticity		– 0.02		– 0.02		– 0.05		– 0.05
(at the average limit price)		(– 3.2)		(– 0.6)		(– 2.5)		(– 1.6)
Range size			0.80	0.66	0.77	0.64	1.26	1.32
			(1.4)	(1.2)	(2.3)	(1.8)	(2.4)	(2.3)
Adjusted *R*-squared	3.9%	5.4%	7.3%	– 0.7%	12.5%	17.3%	28.5%	25.6%
N	36	34	36	34	36	34	36	34

Table IX
Aftermarket Return by Bidder Types: IPOs

This table reports regression coefficients (and heteroskedasticity-adjusted *t*-statistics in parentheses) for various model specifications. The dependent variable is the first-day aftermarket return benchmarked relative to the domestic stock market index. The average limit price is the quantity-weighted average of all limit prices. *Oversubscription* is the logarithm of 1 + total demand/supply of shares. Large (small) bids are bids with a quantity above (below) the median in an issue. Frequent (infrequent) bidders are bidders who participate in at least (fewer than) three issues. Early bids are bids received at least three days prior to the closing of the book. Late bids are bids received in the last three days. The symbols †††,†† denote *pairs of coefficients* that are significantly different from each other at the one and five percent confidence levels, respectively.

Dependent Variable: First-Day Return (Benchmarked)	Reg 1	Reg 2	Reg 3
Intercept	−0.10	−0.05	−0.10
	(−2.6)	(−1.7)	(−1.6)
Percentage difference between average limit price and issue price	−0.47	−0.37	0.18
	(−1.2)	(−1.0)	(0.3)
Oversubscription (large bids)	0.13†††		
	(3.6)		
Oversubscription (small bids)	−0.20†††		
	(−2.5)		
Oversubscription (frequent bidders)		0.08††	
		(3.4)	
Oversubscription (infrequent bidders)		−0.02††	
		(−0.7)	
Oversubscription (early bids)			0.04
			(1.7)
Oversubscription (late bids)			0.09
			(2.2)
Adjusted *R*-squared	43.6%	42.9%	43.6%
N	34	34	34

being issued was large relative to the shares already trading. The banker was concerned that the issue of additional stock might affect the market price, so he could not completely rely on the existing price.

In Table X, we study the choice of the issue price in SEOs. SEOs do not have initial price ranges, since the preissue information is captured by the market price prior to the offering. Therefore, the normalized dependent variable in the regressions is the percentage difference between the issue price and the last premarket price before the issue. The independent variables are the average limit price (also normalized relative to the premarket price), oversubscription, and elasticity of demand. In Regression 1, we find that even for SEOs, the average limit price is very important (p-value = 0.000), although the offer price does not

Table X
The Choice of the Issue Price (SEOs)

This table reports regression coefficients (and heteroskedasticity-adjusted *t*-statistics in parentheses) for various model specifications. The dependent variable in Regressions 1 to 4 is the issue price normalized by the premarket price, while in Regression 5 the dependent variable is the absolute value of the percentage difference between issue price and average limit price. *Average limit price* is the quantity-weighted average of all limit prices and is normalized by the premarket price. *Oversubscription* is the logarithm of 1 + total demand/supply of shares. *Elasticity* is computed from the average limit price to a price one percent higher. Large (small) bids are bids with a quantity above (below) the median in an issue. Frequent (infrequent) bidders are bidders who participate in at least (fewer than) three issues. Favored bids are bids that are awarded more shares (as a percentage of the bid quantity) than the median bidder. The symbol † denotes *pairs of coefficients* that are significantly different from each other at the 10 percent confidence level.

	Dependent Variable: Issue Price (Normalized by Premarket Price)				Dependent Variable: Absolute Value of the Percentage Difference between Issue Price and Average Limit Price
	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5
Intercept	− 0.01	− 0.02	− 0.02	− 0.02	0.01
	(− 1.3)	(− 1.9)	(− 1.7)	(− 2.2)	(2.1)
Average limit price	0.58				
(all bids)	(5.6)				
Oversubscription	0.00	0.00	0.00	0.00	0.00
(all bids)	(0.1)	(0.5)	(0.6)	(0.3)	(0.7)
Elasticity	− 0.04				− 0.13
(at the average limit price)	(− 0.7)				(− 2.7)
Average limit price		0.64†			
(large bids)		(2.6)			
Average limit price		0.09†			
(small bids)		(0.9)			
Average limit price			0.38		
(frequent bidders)			(2.2)		
Average limit price			0.40		
(infrequent bidders)			(5.0)		
Average limit price				0.75†	
(favored bids)				(5.0)	
Average limit price				− 0.01†	
(nonfavored bids)				(− 0.1)	
Adjusted *R*-squared	55.6%	57.2%	59.4%	64.3%	2.4%
N	26	24	26	25	26

move one for one with the average limit price as it does for IPOs. However, oversubscription and elasticity of demand are not statistically significant. Although these results are less strong than those for IPOs, they show that even for SEOs, there is information provided by investors through bookbuilding beyond the existing market price.

In Regressions 2 through 4, we find that limit prices from different categories of bidders have different impacts on the issue price. As for IPOs, large bids and bids from favored bidders (as determined by the ex post allocation of shares) are also more relevant in determining the issue price. In contrast to the IPO results, there is no statistically significant difference between the coefficients of the average limit price from frequent and infrequent bidders.

Regression 5 examines whether the investment banker relies more on the average limit price when the investors agree about the share value, that is, when the elasticity of demand is higher. As in the case of IPOs, the higher the elasticity, the less the investment banker deviates (in absolute value) from the average limit price.

In Table XI, we study the first-day aftermarket returns of seasoned issues. Since the issue price deviates from the premarket price, we first look at whether the aftermarket price reverts to the original level. To capture this effect, we use the percentage difference between premarket price and issue price as an independent variable. The regressions also include independent variables for oversubscription, the percentage difference between average limit price and issue price, elasticity of demand, the volatility of the market price in the month preceding the bookbuilding, and oversubscription from different subsets of bidders. The variable that is consistently related to aftermarket return is the percentage difference between premarket price and issue price. For almost all the regressions, the coefficient is significantly different from zero, but not significantly different from one. On average, when the issue is priced at a discount, the aftermarket price reverts to its premarket level.

This result is consistent with Smith (1977), who shows that in fixed price offerings, the offer price is below the market price both before and after the new issue. It can be explained by Parsons and Raviv's (1985) model in which the offer price is set sufficiently low to encourage investors with high valuations to purchase shares at the offering, rather than buying shares at a subsequently lowered price. In the context of bookbuilding, our results indicate that the investment banker looks at investors' reservation values, to determine an issue price at which he will be able to place the shares.

We find no evidence that aftermarket returns can be predicted by total oversubscription. In contrast, when oversubscription is separated into different groups of bidders (Regressions 3, 4, and 5), we find that oversubscription from large bids, frequent bidders, and late bidders is related to post-SEO returns. Regarding uncertainty prior to the issue, we find that elasticity, which serves as a proxy for uncertainty at the end of bookbuilding, is significantly related to aftermarket returns. The preissue volatility of the stock price, which is a proxy for uncertainty before and during bookbuilding, is positively related to aftermarket returns but of only marginal statistical significance (p-value $= 0.089$).

VI. Conclusions

We examine 63 books built by a large investment bank prior to both IPOs and SEOs. We find a strong relation between the limit prices submitted by bidders and

Table XI
Aftermarket Return (SEOs)

This table reports regression coefficients (and heteroskedasticity adjusted *t*-statistics in parentheses) for various model specifications. The dependent variable is the first-day aftermarket return benchmarked relative to the domestic stock market index. *Oversubscription* is the logarithm of 1 + total demand/supply of shares. The average limit price is the quantity-weighted average of all limit prices. *Elasticity* is computed from the issue price to a price one percent higher. *Preissue volatility* is based on market prices during the one month before bookbuilding. Large (small) bids are bids with a quantity above (below) the median in an issue. Frequent (infrequent) bidders are bidders who participate in at least (fewer than) three issues. Early bids are bids received at least three days prior to the closing of the book. Late bids are bids received in the last three days. The symbols †††,†† denote *pairs of coefficients* that are significantly different from each other at the one and five percent confidence levels, respectively.

Dependent Variable: First-Day Return (Benchmarked)	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5
Intercept	−0.03	−0.03	−0.04	−0.04	−0.03
	(−0.9)	(−1.3)	(−1.9)	(−2.3)	(−1.3)
Percentage difference between premarket price and issue price	0.96	0.93	0.99	1.20	1.06
	(2.2)	(2.0)	(2.4)	(3.6)	(2.5)
Oversubscription (all bids)	0.03	0.02			
	(1.3)	(0.9)			
Percentage difference between average limit price and issue price	0.31	0.03	0.18	0.09	0.13
	(0.6)	(0.1)	(0.4)	(0.2)	(0.3)
Elasticity (at the issue price)	0.002				
	(2.2)				
Preissue volatility		0.09			
		(1.7)			
Oversubscription (large bids)			0.06††		
			(2.7)		
Oversubscription (small bids)			−0.12††		
			(−1.7)		
Oversubscription (frequent bidders)				0.06†††	
				(5.0)	
Oversubscription (infrequent bidders)				−0.04†††	
				(−2.3)	
Oversubscription (early bids)					0.01
					(0.7)
Oversubscription (late bids)					0.04
					(2.0)
Adjusted R-squared	18.9%	25.8%	28.2%	39.1%	19.1%
N	25	25	25	25	24

the issue price, especially for bids from large and frequent bidders. The level of oversubscription has a smaller but significant effect on the issue price for IPOs. We do not find that oversubscription is generally related to SEO prices. Although certain publicly available information affects IPO prices, this information mostly affects the issue price via the bids. These results support the hypothesis that the

investment banker extracts pricing information from investors through the bookbuilding process.

We also find a positive relation between oversubscription and aftermarket returns in IPOs. We interpret this relation as the investment banker only partially adjusting for the information in oversubscription when he sets the issue price. Elasticity of the demand, which captures the consensus among bidders, is positively related to aftermarket returns and negatively related to aftermarket volatility.

Finally, we find that when the price of a seasoned equity offering differs from its premarket price, the aftermarket price tends to revert to the premarket level.

REFERENCES

Aggarwal, Reena, Nagpurnanand R. Prabhala, and Manju Puri, 2002, Institutional allocation in initial public offerings: Empirical evidence, *Journal of Finance* 57, 1421–1442.

Benveniste, Lawrence M., Walid Y. Busaba, and William J. Wilhelm, 2002, Information externalities and the role of underwriters in primary equity markets, *Journal of Financial Intermediation* 11, 61–86.

Benveniste, Lawrence M., Alexander Ljungqvist, William J. Wilhelm, and Xiaoyun Yu, 2003, Evidence of information spillovers in the production of investment banking services, *Journal of Finance* 58, 577–606.

Benveniste, Lawrence M., and Paul A. Spindt, 1989, How investment bankers determine the offer price and allocation of new issues, *Journal of Financial Economics* 24, 213–232.

Benveniste, Lawrence M., and William J. Wilhelm, 1990, A comparative analysis of IPO proceeds under alternative regulatory environments, *Journal of Financial Economics* 28, 173–207.

Cornelli, Francesca, and David Goldreich, 2001, Bookbuilding and strategic allocation, *Journal of Finance* 56, 2337–2370.

Ellis, Katrina, Roni Michaely, and Maureen O'Hara, 2000, When the underwriter is the market maker: An examination of trading in the IPO aftermarket, *Journal of Finance* 55, 1039–1074.

Hanley, Kathleen W., 1993, The underpricing of initial public offerings and the partial adjustment phenomenon, *Journal of Financial Economics* 34, 213–250.

Kandel, Shmuel, Oded Sarig, and Avi Wohl, 1999, The demand for stocks: An analysis of IPO auctions, *Review of Financial Studies* 12, 227–248.

Ljungqvist, Alexander, Tim Jenkinson, and William J. Wilhelm, 2003, Global integration in primary equity markets: The role of U.S. banks and U.S. investors, *Review of Financial Studies* 16, 63–99.

Loughran, Tim, and Jay R. Ritter, 2002, Why don't issuers get upset about leaving money on the table in IPOs?, *Review of Financial Studies* 15, 413–443.

Lowry, Michelle, and G. William Schwert, 2002, Is the IPO pricing process efficient? *Journal of Financial Economics*, forthcoming.

Parsons, John, and Artur Raviv, 1985, Underpricing of seasoned issues, *Journal of Financial Economics* 14, 377–397.

Sherman, Ann E., 2000, IPOs and long term relationships: An advantage of book building, *Review of Financial Studies* 13, 697–714.

Smith, Clifford W., 1977, Alternative methods for raising capital: Rights versus underwritten offerings, *Journal of Financial Economics* 5, 273–307.

Spatt, Chester, and Sanjay Srivastava, 1991, Preplay communication, participation restrictions, and efficiency in initial public offerings, *Review of Financial Studies* 4, 709–726.

White, Halbert S., 1980, A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity, *Econometrica* 48, 817–838.