Bookbuilding: How Informative is the Order Book?*

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This Version: May, 2001

Abstract. When using a formal bookbuilding procedure, underwriters observe the demand curves of investors as stated in the "book" prior to pricing shares in an equity issue. The purpose of this paper is to examine whether the investment bank uses the information in the book when setting the issue price and whether this information can help predict subsequent secondary aftermarket prices. We examine the details of the institutional bids for shares for a sample of 63 international equity issues. We find that the issue price is closely related to the limit prices submitted by bidders. The level of oversubscription has a smaller but significant effect. The price primarily reflects the information in the price contingent bids of certain bidders such as large bidders and frequent bidders. Aftermarket returns in IPOs are positively correlated with oversubscription and elasticity of the demand.

*We are grateful to Ulf Axelson, Alon Brav, Ian Cooper, Espen Eckbo, Leonardo Felli, Mike Fishman, Arif Khurshed, Alexander Ljungqvist, Ron Masulis, Kristian Rydqvist, Ingrid Werner, Bill Wilhelm and seminar participants at City University - London, London Business School, Ohio State University, Hebrew University, University of Georgia, Tel Aviv University, the conference on "Primary Equity Markets" in Capri, June 2000, the 2000 CEPR Finance Symposium in Gerzensee, the 2000 ABN-AMRO International Conference on IPOs in Amsterdam, the 2000 European Finance Association Meetings, the 2001 American Finance Association meetings, the 2001 Utah Winter Finance Conference, and the 2001 Texas Finance Festival for helpful comments. We thank Sebastian de Ramon, Burcin Kasapoglu and Purnendu Nath for excellent research assistance. The project was supported by an LBS Research Grant. Part of this work was done while F. Cornelli was visiting the Wharton School, whose generous hospitality is gratefully acknowledged.

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1. Introduction

Prior to setting the issue price for an equity offering, an investment banker collects bids for shares from investors. The information from this "bookbuilding" procedure is available to the investment banker at the time of pricing the issue. In this paper we examine the information from investors' bids which represent their demand for the stock. We study how the investment banker uses the information in the book to set the issue price, and how the information is reflected in the post-issue market price behavior.

The literature has extensively studied the price behavior around equity issues, in particular for initial public offerings (IPOs).[1] Usually, it is only possible to observe the price set by the investment bank and the following market price. Some other information, such as an indicative range of prices or analysts' recommendations, is also often available, but in general little is known about investors' demand for the stock or the information available to the investment banker prior to the issue.

However, when using the bookbuilding procedure, the investment bank collects manifestations of interest from institutional investors before pricing an equity issue. These manifestations of interest take the form of bids, in which each investor requests a quantity of shares, and may also quote the maximum price he is willing to pay (i.e. a limit price). Once the bookbuilding process is concluded, the investment bank aggregates all of the bids into a demand curve and chooses the issue price not according any pre-specified rule but at his discretion. Thus, when pricing an issue, the investment banker has a considerable amount of information available about how the market values the issue.

In order to better understand the pricing and aftermarket returns of equity issues, it is important to know what information is available and how the underwriter chooses the issue price. Although the book with the bid details is kept confidential and generally cannot be studied, we have obtained the book for 63 international equity issues from a major European investment bank and are able to conduct such a study.

[1] For an overview, see Ibbotson, Sindelar and Ritter (1994) and Ritter (2001).

With this unique database, we can address an important question: is there information in the bids submitted by investors? To study whether there is information, we look at two different levels. First of all, we investigate whether the investment banker uses these bids when choosing the price of the issue. If this is the case, his behaviour suggests that he considers the investors' manifestations of interest as containing relevant information. Second, we analyze whether there is information in the bids that is not completely summarized in the issue price and can predict aftermarket returns. This would again suggest that these manifestations of interest contain information about the shares value.

On the first level, we find very strong evidence that the underwriter extensively uses the information contained in the book. In particular, limit prices submitted by bidders have a very strong influence on the choice of the issue price. The price is set very close to the weighted average of all limit prices. The level of oversubscription also affects the offer price, but to a lesser degree.

This result is consistent with the evidence in Cornelli and Goldreich (2001). They find that the investment banker, when allocating shares, favors limit bids relative to other bids and suggest that the more favorable treatment could be explained as compensation for the information contained in the limit bids. In this paper we look at the choice of the price, rather than the share allocations, and find that indeed the limit bids provide information which is used in pricing the issue.

Not all issues in our data set are IPOs. Some of the issues are seasoned equity offerings (SEOs), yet the investment banker built a book because the outstanding equity was illiquid or small relative to the size of the new issue. Despite the fact that there is already a market price, we observe that the investment banker deviates from the premarket price on the basis of the information contained in the book and the deviations from the premarket price are closely related to the weighted average of the limit prices submitted by investors.

Given this result, we look at the book in more detail to discover which type of bids the investment banker relies on most when choosing the issue price. We find that the investment bank is more influenced by large bids and by bids coming from

frequent investors. We also find that bids who are favored in the allocation of shares are the ones which influence most the issue price. This is consistent with the view that through bookbuilding the investment bank collects information, in exchange for better allocations to those who provide the information.

Additional insight is gained by looking at the first-day aftermarket returns. If the investment bank incorporates all of the information available when setting the issue price, then the bids in the book should not be able to predict the aftermarket returns at all. We find that exactly the information that is less used in setting the issue price can help predict aftermarket returns.

A high level of oversubscription is a signal of a "hot" issue. However, the issue price only partially reflects the information in the oversubscription. As a result, a high level of oversubscription is correlated with a positive aftermarket return. Additionally, the more disperse limit prices are (which can be interpreted as a measure of the market's lack of consensus about the stock's value and measured as low elasticity of demand), the lower are the aftermarket returns and the higher the aftermarket price volatility. The fact that differences of opinion among investors affect returns and volatility is consistent with the idea that price-contingent bids contain information about the investors' perception of the value of the shares and are not simply reflecting their budget constraint or their desire to protect themselves. For seasoned issues, we detect a tendency of the aftermarket price to return towards the premarket price, which is consistent with the theory proposed in Parsons and Raviv (1985): the investors are revealing their reservation price, at which they are willing to buy the shares in the issue instead of buying them afterwards in the market.

We also study how the evolution of the book affects pricing. We find that the most recent limit prices are more relevant and incorporate most of the information from earlier limit prices. This is consistent with investors conveying their beliefs about the shares' value through limit bids and these beliefs being refined over time, or moving with the market. In contrast, oversubscription from early bids is more relevant—which suggests that the investment bank wants to know whether the demand is due to a genuine interest in the stock or if it is only momentum building up at the end of

the process.

The idea that investors may have information useful in the pricing of IPOs has long been present in the literature. Benveniste and Spindt (1989) argue that under the bookbuilding procedure, the investment banker can use information from informed investors to price the issue more accurately and reduce the winner's curse. Similarly, Spatt and Srivastava (1991) model this bookbuilding procedure as preplay communication in which the investors convey their private information to the investment banker, who then uses it to price the issue. This paper is the first to empirically show that information is flowing from investors to the investment banker. Moreover, the detailed nature of the data allows us to look not only at the information provided in the aggregate, but also at the informativeness of each type of bids.

Other papers in the literature have looked at some of the information available when the offer price is chosen and studied the relationship between the information and aftermarket returns. Hanley (1993) looks at the relation between the IPO offer price and the preliminary price range and finds that issues priced at the top of the range perform better in the aftermarket (the partial-adjustment phenomenon). Similarly, Loughran and Ritter (2001) document that most of the underpricing comes from the minority of IPOs in which the offer price was revised upwards from the anticipated price at the time of the preliminary prospectus. Krigman, Shaw and Womack (1999) show that available information about the quality of issues can predict aftermarket returns, while Lowry and Schwert (2001) show that the issue price relative to the initial price range is related to information available at the time of the preliminary prospectus. The advantage of this paper is that we use detailed information about demand for shares, and can observe the information that the investment banker has when he chooses the issue price.

The next section describes the data and the bookbuilding procedure. Section 3 studies the choice of the issue price, Section 4 considers how the evolution of the book affects the issue price, and Section 5 discusses the aftermarket price behavior. Section 6 concludes.

2. Description of the Bookbuilding Procedure and Summary Statistics

We analyze the book of a major European investment bank for 63 international equity issues between early 1995 and late 1999. The issuing companies come from 24 different countries and many different industries. Of these issues, 37 are IPOs and 26 are seasoned issues.[2] Twenty of the 63 issues are privatizations (both IPOs and later tranches).

In the case of IPOs, before soliciting bids from investors, the investment banker announces an initial price range within which he expects to price the issue. This range is only indicative and the final issue price may be outside the range. In our sample, the average size of this range, as a percentage of its midpoint, is 16%. 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 50% of the way between the bottom and the top of the range. (The median is 67% of the distance from the bottom to the top of the range.)

In our sample there are five IPOs for which the price is set outside of the initial range—on four occasions below the minimum price and once above the maximum price. Moreover, twice it is set exactly at the bottom of the range and nine times exactly at the top of the range. This concentration of issues priced at the extremes of the range (in particular at the top of the range) is consistent with Jenkinson, Ljungqvist and Wilhelm's (1999) result for a large set of international equity offerings and suggests that the banker may use different criteria when choosing an offering price for issues that might otherwise be priced outside the range. Moreover, the fact that the investment banker is more willing to price the issue below the range minimum than above the range maximum is consistent with the finding in Lowry and Schwert

[2]As mentioned in the introduction, the investment bank claimed that the reason it used the bookbuilding procedure despite a readily available premarket price was that either the shares were illiquid or the number of shares being issued was so large relative to the shares already trading and the banker was afraid that the issue of additional stock would move the market. In other words, the investment bank did not think it could rely completely on the existing market price.

(2001) that the investment bankers appear to incorporate negative information more fully into the offer price than positive information.

For seasoned equity offerings no initial price range is given, as there is already a market price to serve as an indication. On average, the seasoned offerings in our sample are priced at a discount of 2.2% relative to the premarket price (i.e. the last market price before the issue price was set). The median discount is 1.9%. The histograms of the issue prices for IPOs (relative to the range) and seasoned issues (relative to the premarket price) are shown in Figure 1.

Bids can be denominated either in shares or 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 and 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). Seventeen percent of all final bids are limit bids, 3.8% are step bids, and 79.3% are strike bids.

On average, there are 344 bids in each issue (the median is 280). In our sample, there are 7905 different bidders.[3] Of these bidders, 318 (4%) participated in at least 10 issues and submitted 37.4% of all the bids. The number of bidders who participated in at least 3 issues is 1500 (19%) and they submitted 67.1% of all bids.

After collecting the bids, the investment banker aggregates all of the bids into a demand curve and chooses an issue price. Figure 2 displays the demand curve for one issue as an example. Although the demand of investors is observed by the investment bank, the issue price is not set at the point where demand equals supply.[4] Rather, the investment banker chooses a price at his discretion that is below the market-clearing price. Once the issue price is set, the investment banker decides how to allocate the shares among the investors.

[3]This count separates multiple departments within the same organization, for example, branches of the same investment management group in different countries, or the asset management and private banking functions within a bank.

[4]For the specific issue represented in Figure 2 there exists no such price, since the demand is above the supply over all the range.

Issues differ substantially in terms of demand: some issues are barely subscribed, while others are heavily oversubscribed. Figure 3 shows the oversubscription (i.e., total demand divided by total supply) for the issues in our sample.[5] The median oversubscription corresponds to a total demand of three times the total supply and the average oversubscription is 6.6. Some issues were heavily oversubscribed—up to 62 times the number of shares offered. In Figure 3 the oversubscription is computed at the issue price. However, the level of oversubscription (or, more precisely, the demand) depends on the price at which it is computed. The problem with considering oversubscription at the issue price is that it is endogenous. The investment banker is effectively choosing the oversubscription when he chooses the issue price. Therefore, 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. This measures the demand due only to strike bids. We also compute the oversubscription at a price just below the lowest limit price, which captures all of the bids. The difference between these two measures of oversubscription is the oversubscription due to demand from limit and step bids.[6] The average oversubscription including all bids is 7.2, for strike bids alone it is 5.6 and for only price-contingent bids it is 1.6.

Note that in general the quantity demanded by each individual bid is not very large relative to total number of shares offered. For example, if we consider only the larger bids — i.e., those above the median size within an issue — these large bids average just 4.3% of the offering size.

In general, IPOs show a much larger degree of uncertainty than seasoned offerings, as one would expect. For IPOs, the average oversubscription including all bids is 9.9, (with a standard deviation of 12), while for SEOs it is just 3.4, (with a standard deviation of 1.7). Moreover, the standard deviation of the issue price of IPOs (relative to the range midpoint) is more than five times the standard deviation of the issue

[5]When we measure oversubscription, the supply includes all shares allocated including those backed by the overallotment option.

[6]The difference between the two measures of oversubscription also includes the downward slope due to bids denominated in currency units. This is only a small effect.

price of seasoned issues (relative to the premarket price).

Another measure that we consider is the elasticity of the demand, 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 in that issue is very elastic. But when limit prices are disperse or when there are few limit or step bids, the demand is inelastic. If there is more uncertainty about the true value of IPOs than of seasoned offerings, we should expect lower elasticity in IPOs than in seasoned offerings. One might consider the elasticity at the issue price, but should remember that the issue price is chosen by the investment banker. It is possible that the banker sets the issue price differently depending on whether the demand is elastic or not. We compute the elasticity both at the issue price and at the average limit price and measure it over an interval from the issue price or average limit price to a price which is 0.5% or 1.0% higher.

Regardless of the measure used, the average elasticity of demand for seasoned issues is higher than the average elasticity for IPOs. When measured on the interval from the average limit price to a price 0.5% higher, the average elasticity for IPOs is 5.9 and for SEOs it is 23.1. (When measured over the interval from the average limit price to a price 1.0% higher, the average elasticities are 6.4 and 16.8 for IPOs and SEOs, respectively.) The differences are statistically significant. When measured around the issue price, the differences between IPOs and SEOs are smaller and not statistically significant.

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, they can transform bids from limit to strike bid (or vice versa), and they can cancel bids. Consequently, the number of shares demanded can change considerably over time. In Figure 4 we show how the oversubscription evolves in the last four days of the book. While most of the issues build up gradually, a few of them show a jump in demand on the last day.

After the bookrunner sets the price and allocates the shares, the shares begin trading. On average, the IPOs in our sample have a one-day return of 6.9% and the SEOs have a one-day return of 5.0%. When benchmarked against the domestic stock

market, IPOs and SEOs show one-day returns of 7.6% and 3.3%, respectively.

Our data set includes all of the information in the book including each bid submitted, the identity of the bidder, the number of shares (or dollar amount) requested as well as any limit prices. In addition, the book contains the date when the bid was entered and any subsequent revision (or cancellation) of the bid.

3. Determining the Issue Price

In this section we study how the investors' manifestations of interest as recorded in the book are used by the investment banker when choosing the issue price. If the book were built only for the purpose of managing the distribution of shares more easily, then the demand from the book should not be used to price the issue. However, if the investment banker feels that investors have important information that is conveyed through the book, then the bids in the book will be used for pricing the shares. Knowing how the bids in the book are used in pricing is also useful when we study aftermarket returns because any information that is already summarized in the issue price should not predict aftermarket returns. In the case of SEOs, it is particularly interesting to see if the investment banker deviates from the premarket price on the basis of the demand from the book because this would suggest that the book contains information which is not incorporated in the premarket price.

We analyze IPOs and SEOs separately. Although the bookbuilding procedure is similar in both cases, the crucial difference between them is that prior to bookbuilding there is a different amount of public information about the value of the shares. For IPOs, the pre-bookbuilding information includes the initial price range. For seasoned offerings the pre-issue market price is known.

When studying the effect of the information in the order book on the issue price, we must condition on the information already available prior to the bookbuilding process. This is handled in the normalization procedure. We normalize the IPO price relative to the initial indicative price range, so that an issue priced at the bottom of the range is set to zero and an issue priced at the top of the range is set to one. Formally, the normalized issue price is equal to $(P_I - P_{min})/(P_{max} - P_{min})$, where

P_I is the issue price and P_{max} and P_{min} are, respectively, the top and bottom of the initial price range. An issue price at the midpoint of the range would be normalized to 0.5. The normalized issue price is below zero or above one when the issue is priced outside the initial range.

This normalization procedure makes two adjustments. First, it relates the issue price to the midpoint of the range which essentially assumes that prior to bookbuilding the expected issue price is equal to the midpoint of the range. Second, it adjusts for the size of the range. When the issue price differs by a fixed amount from the midpoint, it is considered a large adjustment if the range is small, but it is considered a small adjustment if the range is large. This procedure assumes that a large range reflects a large degree of uncertainty prior to bookbuilding. An alternative normalization procedure is simply 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. The analysis in this paper has been repeated with the alternative normalization with very similar results.

The fact that the normalized issue price is equal to 0.51 - almost exactly the midpoint of the range - supports the use of the range as a proxy for the market's pre-bookbuilding expectation of the issue price. Empirically, the size of the range (as a percentage of the midpoint) is related to variations in 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 (and is statistically significant at the 5% level). Once normalized, there is no longer any correlation between the size of the range and the absolute value of the difference between the issue price and the midpoint. This suggests that the normalization procedure correctly adjusts for the uncertainty in the issue price.[7]

Seasoned offerings do not have initial price ranges. The information known to the market is the market price prior to the issue. Therefore, we define the normalized

[7]The normalization procedure 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 this correlation is not statistically significant.

SEO price as the percentage difference between the issue price and the last pre-market price before the issue data, i.e. $(P_I - P_M)/P_M$.

The information in the book is mainly contained in the quantities demanded by investors and in the limit prices. We capture the quantity demanded with various measures of oversubscription (more precisely, the logarithm of one plus oversubscription). We particularly focus on oversubscription measured at at a price equal to the lowest limit price, which is the one corresponding to the demand for all bids, but we also use oversubscription corresponding to strike bids only (i.e. measured at a price just above the highest limit price), oversubscription corresponding to limit and step bids only (which is given by the difference between the two measures of oversubscription above), and the oversubscription measured at the issue price. Limit prices are characterized by their average and standard deviation. The average limit price includes both limit bids and step bids and is weighted by the quantity of each bid. The average limit price is normalized relative to the initial range. Similarly, the standard deviation of the limit prices is also quantity weighted and normalized.

In Table 1 we present the results of the analysis that relates the normalized IPO price to the bids in the book. In Panel A, Regression 1 shows that the coefficient of the average limit price is positive and very significantly different from zero, but not significantly different from one. This regression has an adjusted R-squared of over 80%, indicating that the limit prices are used to a large degree by the investment banker to determine the issue price.

This result is consistent with the literature that assumes that bookbuilding is used to extract information from investors. In particular, it is consistent with Cornelli and Goldreich (2001) who show that when allocating shares the investment bank favors the investors who submit limit and step bids relative to bidders who submit strike bids. They argue that this is compensation for revealing useful price information. Indeed, here we find that the investment banker is relying heavily on the information contained in the limit prices in order to price the issue.

The coefficient of the oversubscription variable (in Regressions 2 and 3) is also positive and significant. However, when oversubscription is considered alone the R-

squared is much lower than when both oversubscription and the average limit price are included in the regression. This implies that the average limit price is much more important in determining the issue price than the oversubscription. This relative importance of oversubscription and the average limit price can also be seen by looking at the size of the coefficients. For example, using the coefficients of Regression 3, suppose an issue has an initial price range of 50 to 60 dollars. If the average limit price increases by one dollar, the issue price also increases by approximately one dollar. In order to increase the issue price by the same amount the demand for shares would have to increase by at least 68%. Thus it takes a very large change in oversubscription to have the same effect on the issue price as a moderate change in the limit prices. In particular, the logarithm of 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.

Before continuing our analysis, we must ensure that the very strong relationship we found between the average limit price and the issue price (and the high R-squared) is not driven by the normalization of the issue price relative to the range. We check for this in several ways. First, a negative correlation between the size of the range and the average limit price could artificially strengthen the results, but the correlation, although negative, is not statistically significant. Second, in Regression 1 of Table 1, Panel B we repeat Regression 3 of Panel A but with a normalization relative to the midpoint of the range: the result is similar.

We also repeat the regression by using a market-adjusted range in Regression 2 of Panel B. The market-adjusted range controls for market-wide movements while the book is open. In this way we ensure that the observed relation is not driven by market movements that push the limit prices and the issue price in the same direction. Suppose that the initial range is set at $[P_{min}, P_{max}]$. If over the life of the book the stock market rose by a rate r, then our expectations of the issue price should go up by r and the limit prices should also go up by r inducing correlation. In order to correct for this, we define the benchmarked range as $[(1+r)P_{min}, (1+r)P_{max}]$, where r is defined as the total return on the domestic stock market from the date of the

first bid in the book until the pricing date. Again the results are very similar.

Finally, Regressions 3 and 4 in Panel B include the size of the range as a percentage of its midpoint as an explanatory variable. Once again the average limit price remains very significant suggesting that the strong relation between issue price and average limit price is robust, and not due to a correlation between size of the range and issue price.

Regressions 3 and 4 are also interesting per se. A wider initial price range suggests that the investment banker has more ex-ante uncertainty about the value of the stock. If this excess uncertainty is not resolved he might price the issue more conservatively. On the other hand, any downward bias in the pricing may be taken into account with the level of the initial range and thus would not show up in the normalized price. The results of the regressions show that the effect of the range size on the normalized IPO price is negative but not statistically significant.

Returning to Panel A, we look at whether using different measures of oversubscription (mostly by considering different points along the demand curve) changes the results: as seen in Regressions 4, 5 and 6 in Panel A, most of the results do not qualitatively change.[8] The only measure of oversubscription which does not have a statistically significant coefficient is the oversubscription due to limit and step bids alone. If we interpret these bids as informed, the amount of shares demanded by these bidders may be more of an indication of how many bidders are informed, rather than the extent of the demand for shares. After extracting the information from the limit prices, additional information can be gleaned from the total oversubscription from all bidders to refine the issue price.

In Regression 7 we divide the total oversubscription between two terms: the first is the logarithm of the number of bids in the issue, the second is the average demand per bid divided by total supply (i.e. the per capita oversubscription). The purpose is to see whether what matters for the oversubscription is the number of bidders or

[8]We also used the oversubscription measured at the average limit price and at the midpoint of the range. We do not present the results, as they are very similar to the ones in Table 1.

the quantity demanded by each bidder. It is evident from Regression 7 that both dimensions are relevant.

Regression 8 includes the standard deviation of the limit prices since similar bids may provide stronger information than disperse bids. A negative coefficient would suggest that the price is set more conservatively when there is less of a consensus among the bidders. However, the coefficient, although negative, is not significantly different from zero.

The consensus of bidders can also be captured by the elasticity of the demand. A more elastic demand implies a higher consensus among investors—or at least among those who submit price-contingent bids.[9] Rather than measuring elasticity at the issue price, which is endogenous, we measure elasticity at the average limit price.[10] Regression 9 includes the elasticity of the logarithm of the demand at the average limit price (over a range going up by 1.0%).[11] However, the coefficient of elasticity is not significant.

One might argue that when the seller is the government (i.e. in a privatization) the price may be set in a different way. In particular the government may be worried that an unsuccessful privatization may hurt its political reputation and it may be more conservative in setting the price. Since our data set contains a number of privatizations, in Regression 10 we consider the effect of the average limit price for privatizations and non-privatizations separately. Both coefficients are significantly positive and are not significantly different from each other. This is consistent with Huang and Levich (1998), who find similarities in the way that shares are sold in privatizations and non-privatizations.

In all of these regressions, the coefficient of the average limit price is not signif-

[9]The advantage of elasticity is that it also takes into account the number of limit and step bids: if there is only a small number of close limit prices, the standard deviation is low, but the demand may still not be elastic.

[10]We also estimate the coefficient of the elasticity at the issue price. The results do not change.

[11]In the previous section, for descriptive purposes the elasticities of demand rather than the logarithm of demand. Here we use the elasticity of logarithm of demand for the same reasons that we consider the logarithm of oversubscription - we expect elasticity to enter in a nonlinear way. Using elasticity of demand itself does not change the result.

icantly different from one. A coefficient of one means that the investment banker adjusts the IPO price one-for-one with the average limit price. The fact that the banker fully adjusts the issue price with the bidders' limit prices suggests that the limit prices themselves fully account for the information provided by the initial range set by the banker.

The concentration of issue prices exactly at the endpoints of the initial range suggests that bankers are reluctant to price an issue outside the initial price range. In Regression 11 we exclude issues for which the issue price is set at either endpoint of the range. In Regression 12, we exclude all issues which were priced at an endpoint or outside the range. We find that the coefficient on the average limit price remains significantly different from zero and very close to one. In particular, when only the range end points are excluded, the explanatory power of the model is very high. This suggests that when the investment banker prices the issue at the endpoints, he is deviating from his normal pricing rule. As a result the model explains the issue price within (or outside) the range better than at the endpoints. This evidence is consistent with the view that the investment bank convey initial information through the indicative price range, and the investors' limit bids help refine such information. When the information contained in the bids suggests a price very different from the initial information of the investment banker, he is reluctant to fully process this information.

Since we have established that there is a very close relationship between the issue price and the average limit price we now consider how the investment banker deviates from the average limit price when setting the issue price. In Regression 5 of Panel B, the dependent variable is the percentage difference between the issue price and the limit price and the variables which can explain a deviation from the average limit price are the oversubscription, the range size and the elasticity of the demand. While range size and elasticity of demand are not significant, the oversubscription is significant: when oversubscription is large, the investment banker deviates from the price suggested by the limit bids and sets a higher issue price.

While we do not find in Regression 5 that an increase in the range size or in the

elasticity causes a higher or lower issue price relative to the average limit price, it may be due to the fact that the relation is not as simple. More specifically, these variables may not influence the investment banker to set the issue price higher or lower, but simply affect the degree to which the investment banker relies on the average limit price. Regression 6 is similar to Regression 5, but the dependent variable is the *absolute value* of the percentage difference between the issue price and the limit price. The idea is that if the banker is relying less on the limit prices when there is substantial uncertainty at the *beginning* of the bookbuilding process, then a wider range should be associated with larger deviations from the average limit price. In contrast, if the banker relies less on the limit prices when there is uncertainty at the *end* of the bookbuilding process (i.e. when there is less consensus among investors), then a lower elasticity should be associated with larger deviations from the average limit price. We find that the coefficient of the elasticity is negative and significant, suggesting that indeed when there is no consensus between limit bids, the investment banker relies less on the limit bids. The coefficient of the range size, however, is not significant, suggesting that uncertainty at the beginning of the bookbuilding process does not necessarily lead to uncertainty at the end of bookbuilding.

In Table 2 we consider seasoned equity offerings. The dependent variable is the issue price normalized by the premarket price; the independent variables are the oversubscription, the average limit price and the standard deviation of the limit prices (normalized relative to the premarket price). In Regressions 1 through 7 we find that even for SEOs the average limit price is very important (although to a lesser extent than for IPOs), while oversubscription is not significant at all. The standard deviation of the limit prices is also not significant. Although these results are less strong than for IPOs, the significance of the average limit price for seasoned offerings is nonetheless surprising since there is already a market price which should already incorporate the information about the market's beliefs. These results show that for these SEOs there is indeed information provided by investors that the investment banker uses, in addition to the market price, to set the issue price.

In Regression 8 we look at whether the average limit price is used differently for

privatization SEOs than for non-privatizations. We find that the coefficients are not significantly different from each other.

Finally, in Regression 9 we look at whether the investment banker relies more on the average limit price when the investors agree about the share value, i.e. when the elasticity of the demand is higher. As in the case of IPOs, we find that the higher the elasticity, the less the investment banker deviates (in absolute value) from the average limit price.

Tables 1 and 2 show that limit prices and, in the case of IPOs, oversubscription contain information that is used in pricing the issue. This raises the question of whether the information is only in the aggregate numbers or whether some bids are more informative than others. Table 3 addresses the question of whether information from certain bidders is more valuable than information from others. We define a bid as large if the quantity of shares demanded is above the median quantity in that issue. We also distinguish bids depending on whether the bidder is a frequent or infrequent investor, where a frequent investor is one who took part in at least three issues.[12] We define a bid as early if it was one of the first 25% received by the bookrunner.[13]

We find that for both IPOs and SEOs the average limit price of large bids is very important in determining the issue price, while the average limit price of small bids is mostly irrelevant. Limit prices from bidders who frequently participate in the offerings are informative in determining the issue price, while the limit prices from bids of infrequent investors is irrelevant for IPOs but relevant for seasoned issues. This is consistent with the view that each single bid conveys information and some bids are more informative than others. We also find that the average limit price due to late bids is more relevant than that of early bids, especially for IPOs. This is hardly surprising, as during the bookbuilding period new information (which may simply include market-wide movements) may be revealed and late bids contain more recent information.[14]

[12]The analysis was repeated with frequent investors defined as those who participated in at least six issues with very similar results.

[13]In order to determine when a bid is received we use the last date in which the bid was revised.

[14]The number of observations vary in these regressions since observations are lost when there are

We also divide bids between favored and non-favored, where a favored bid is one that is allocated a number of shares—as a percentage of the shares he demands—higher than the median in that issue. The underlying idea is the following: if book-building is designed in order to extract information which is then used to price the issue (as argued by Benveniste and Spindt, 1989), then we know from the mechanism design literature that, since informed investors need appropriate incentives to reveal their information, it is necessary to compensate them. Since the issue price is set so that demand is larger than supply, in general investors will receive less shares than they demand, and the compensation can take place through a more favorable allocation of shares to informed bidders. In Regression 4 (for IPOs) and 8 (for SEOs) we find that the average limit price from favored bids is significantly informative, while the average limit price from non-favored bids is not significantly related to the issue price. This is consistent with Cornelli and Goldreich (2001), who argue that the favorable allocation given to some bids is a remuneration for providing useful information.

We also look at whether the information from the quantity demanded depends on the type of bidder. We present only the results for IPOs, since oversubscription is not a significant predictor of SEOs prices. In Panel B of Table 3 we divide the oversubscription among the different bidder categories. Oversubscription from large bids and frequent bidders is significant but oversubscription from small bids and infrequent bidders is not, although the coefficients of oversubscription for each pair of subsets are not significantly different from each other.[15] However, only the oversubscription from non-favored bids is significant (although the two coefficients are not significantly different from each other), which is in contrast with the result for the average limit prices. However, this is similar to the finding in Table 1 that oversubscription due to limit and step bids is not significant since Cornelli and Goldreich (2001) show that limit and step bids are favored.

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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.

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

Interestingly, oversubscription due to early bids is informative, but oversubscription due to late bids is not (although the coefficients are not significantly different from each other). This suggests that the investment bank may be interested in seeing early and steady interest in the issue and may not find as informative the oversubscription due to late bidders who could be merely following the momentum. We study the timing of bids further in the next section.

4. The Evolution of the Book

The previous section focused on how the final book, at the time when it closes, influences the way in which the investment banker sets the issue price. But bookbuilding can be a long process, which can take up to 3 weeks. Figure 4 shows how the demand in the book builds up over the last few days. We now consider how the evolution of the book affects the choice of the issue price.

In Table 4 we consider the influence of limit prices submitted on the days before the book closed. The left panel considers the average limit price formed by all bids submitted up to day $T-i$, where T is the final day of bookbuilding. The right panel considers the average limit price formed by bids submitted on day $T-i$ only.

We find that the average of the limit prices submitted until a few days prior to the closure of the book predicts the issue price. The coefficient in all cases is significantly positive and in almost all cases not significantly different from one. However, the further back we go, the average limit price has less significance and the model has less explanatory power.

Similarly, when we look at limit prices submitted on individual days, we see that the coefficient of the limit prices from any single day is significantly different from zero and close to one, but limit prices from the earlier days are less significant and give the model less explanatory power. When the average limit prices from each day are included together in a single regression, only the last day and the next-to-last day are significant. Although the limit prices in the early days are individually informative, the limit prices in the last two days contain all of the information from the early bids. However, the reason why day $T-1$ is still important may be due to the fact that the

book was sometimes closed mid-day and in those instances the last day includes only the morning.

To summarize, the investment bank relies primarily on the most recent limit bids, but the early limit bids also have significant predictive power.

In Table 5 we look at the effect of oversubscription prior to the closure of the book. We look at both the oversubscription from all bids submitted until day $T - i$ and the oversubscription due to bids submitted on day $T - i$ alone. Interestingly, oversubscription from the days prior to the closure of the book remains very significant. The information in the early oversubscription is relevant, and only loses a small amount of significance as we go back in time.

Compared with the limit prices, early oversubscription is relatively more informative than early limit prices. When considering the average limit bid, the latest bids contain the most information. In contrast, early oversubscription may inform the investment banker of how demand built up over time. Moreover, early demand may be particularly informative as it comes from bidders who are expressing interest without following the lead of other bidders.

Table 6 reports the results for early limit prices in seasoned issues. (We do not repeat the analysis for oversubscription since even the final level of oversubscription does not have an effect on the pricing of seasoned issues.) Similar to the results for IPOs, the average limit prices on the days prior to the closure of the book have significant explanatory power, but the explanatory power tends to be reduced as we go back in time. Although the coefficients are significantly above zero, in the case of seasoned offerings they are also significantly below one. When the average limit price from each day is included together in a single regression, all of the significance is from the bids on the last day.

5. Information in the Book and Aftermarket Prices

In the previous sections we saw that the investment bank, when setting the issue price, relies on the demand from the book and we interpret it as evidence that the book contains useful information. In this section we investigate whether all the information

contained in the book is captured by the issue price or there is residual information which is not captured by the issue price. Any residual information in the book should allow us to predict the post-issue aftermarket price behavior. Therefore, we analyze the market prices at the end of the first post-issue trading day. These prices are benchmarked relative to the index of the domestic stock exchange of the issuing company. Once again, we distinguish between IPOs and seasoned issues.

5.1. IPOs. The information in the book is mainly contained in the limit prices and the oversubscription. However, we have already shown that the issue price is closely related to the average limit price. Here we ask whether some information contained in the average limit price is not captured completely in the issue price, by considering the percentage difference between the issue price and the average limit price. If the investment banker is already making full use of the information contained in the average limit price, then this variable should not help us predict the aftermarket returns. Similarly, oversubscription, the standard deviation of limit prices and the elasticity of demand will only predict aftermarket returns to the extent that the information they convey is not fully captured by the issue price. Moreover, since the behavior of the investment banker in setting the issue price may depend on where in the range the price might be set (for example, because the investment banker is reluctant to set the issue price outside of the range), we also introduce the issue price normalized by the range as an explanatory variable.

In Table 7, Regression 1, we see that there is a positive and significant relationship between the issue price (normalized relative to the range) and aftermarket returns. Issues priced near the top of the range outperform issues at the bottom of the range by about 7%.[16] This is the partial adjustment phenomenon documented by Hanley (1993). This result does not depend on the information in the book: it simply means that any investor, looking at where the issue is priced relative to the range, can predict returns. Being able to observe the book allows us to check whether the investment

[16]Regression 1 excludes one outlier, which was priced at the top of the range and had 70% first day return. When the outlier is included, the results are much stronger. In order to be conservative, we drop that issue from all regressions related to aftermarket returns.

banker could have set a different issue price, based on the information in the book.

We now document that the book provides additional information that can predict returns. Regression 2 shows that oversubscription predicts returns. Moreover, when both the issue price relative to the range and the oversubscription are included together in Regression 3 the oversubscription captures the entire effect and the issue price relative to the range is no longer significant. This is because one signal that the issue should have been priced high in the range (or above the range) is a large oversubscription.

In general, investors rarely submit limit prices outside of the range: if the issue becomes heavily oversubscribed and it is likely that it will be priced at the top or even outside of the range, investors often revise their limit bids to strike bids. Therefore, when the issue becomes very "hot", this is mostly evident from the oversubscription, not from the average limit price. This is the first reason why the oversubscription is capturing all the effect and predicting aftermarket returns: it is not necessarily the fact that the issue was priced at the top of the range per se, but that the investment banker did not fully respond to the strong signal given by the oversubscription, which is giving the positive aftermarket returns.

Indeed, the negative coefficient of the percentage difference between the average limit price and the issue price in Regression 4 comes from the effect just described: when the banker deviates from the average limit price one can expect the aftermarket price to deviate even further. In particular, when the issue becomes very hot, other factors, such as oversubscription, become more important than the average limit price.[17] In fact, when we introduce oversubscription as well (Regression 5) this effect becomes statistically insignificant.

Since the oversubscription is particularly relevant when an issue is hot, we want to

[17]It should be stressed that the negative coefficient is mainly due to three issues, which were priced much lower than the average limit price and still had negative aftermarket returns. Without these three issues this result disappears. We looked at the press coverage surrounding these three issues and it appears there was a lot of concern about them. The investment banker took this information into account, as is evident from the fact that he deviated heavily from the average limit price. However, judging from the aftermarket returns, he may still have underreacted to the information.

find out whether the predictability of oversubscription is only due to the reluctance of the investment banker to price the issue outside of the range or it is a more general phenomenon. In other words, we want to know whether the investment banker underreacts to oversubscription in general or only when the oversubscription suggests to set an issue price outside of the range. Therefore we restrict the analysis to those issues for which pricing outside of the range was not a concern. In Regression 6 we only consider issues for which the price was set strictly in the interior of the range, while in Regression 7 we look at issues for which the oversubscription is not excessive, i.e. for issues with an oversubscription below eight. We find that the oversubscription coefficient is still positive and significant when we only consider issues priced in the interior of the initial range, but it is not significant when we consider only issues with low oversubscription. Therefore, the positive coefficient does not seem to be 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.

While a large oversubscription seems to be a good predictor of a high price, Regression 7 suggests that low oversubscription is not as good a predictor in the opposite direction. When the banker prices the issue below the average limit price it is because he is receiving negative information from another source. The negative coefficient on the difference between the average limit price and the issue price in Regression 7 suggests that he is underreacting to that outside information.[18]

When studying the choice of the issue price, we argued that a lack of consensus among investors might have affected the issue price, but the coefficient of the standard deviation of the limit prices is not significant. In contrast, in Regression 8 we find that a lack of consensus among bidders, measured by the standard deviation of the limit prices, is negatively related to aftermarket returns and significant: a higher standard deviation suggests that investors have diverse opinions about the value of

[18]Although we do not present the results, all the regressions in this section have been repeated with returns over the period beginning from the end of the first day until the end of the first week and until the end of the second week. We do not find any statistically significant results. However, it may be worth noting that, after the first day, price movement is limited because of underwriter price-stabilization activities (see Ellis, Michaely, and O'Hara, 2000, and Prabhala and Puri, 1998).

the shares and this results in lower returns. Similarly, in Regression 9 and 10 we use the elasticity of demand at the issue price and at the limit price (up to a price 1% higher) and we find that the coefficient is positive and, in the case of the issue price, statistically significant.[19] This result is in line with Kandel, Sarig and Wohl (1999), who find that the elasticity of the demand disclosed by the underwriter is positively related to after-market returns. Kandel, Sarig and Wohl (1999) argue that this may affect the price of the shares for two reasons. First of all, an elastic demand may reflect more accurate investor information about the payoff of the security and may require a lower risk premium. Second, an elastic demand may indicate high future liquidity, which implies lower transaction costs. However, in their case the elasticity is revealed to the market immediately after the IPO auction and the lower aftermarket return is interpreted as a reaction to the elasticity announcement. In bookbuilding, instead, the demand curve remains confidential. This suggests that it is the differences of opinion or differences in valuation themselves that translate into lower returns in the aftermarket.

We investigate further the relevance of the consensus among bidders for aftermarket returns in Table 8. First of all, if limit prices are informative about the value of the shares, then a lack of consensus among limit bidders may be reflected in less predictability in the aftermarket share prices. In Regressions 1 and 2 we test whether consensus among limit bidders, measured by elasticity at the issue price and at the average limit price, respectively, is related to the unexpected portion of aftermarket returns. We compute the expected returns given the range and the oversubscription using Regression 3 from Table 7. The dependent variable is the absolute value of the percentage difference between the aftermarket returns and these expected returns. We find that the higher is the elasticity, the closer the aftermarket returns are to the expected returns. In other words, the more there is consensus among investors about the value of the shares, the more the returns can be predicted using the information in the book.

[19]Note that in Section 3, when studying the choice of the issue price, we computed the elasticity only at the average limit price, since the elasticity at the issue price is endogenously determined. When studying the aftermarket returns this is not a problem.

As we already discussed in Section 3, the uncertainty can be captured at two stages of the process. At the beginning of bookbuilding, the range size can be interpreted as a measure of the uncertainty about the issue. At the end of bookbuilding, the elasticity captures the consensus of the bidders and therefore the remaining uncertainty. In Table 2, we also test whether these variables are related to the aftermarket volatility over the first week, two weeks and one month after the issue. The reason to introduce the range size is that the initial uncertainty may have not been completely eliminated. The elasticity is measured in different ways. In Regressions 3, 5 and 7 we compute the elasticity over an interval from the issue price up to a price which is 1% higher, while in Regression 4, 6 and 8 we compute the elasticity over an interval from the average limit price up to a price which is 1% higher. The coefficient in all cases is negative, and in most it is statistically significant: the larger is the demand elasticity (i.e. the higher is the consensus) the lower is the volatility of the aftermarket returns. This suggests that the differences of opinion among limit bidders remain in the market after the shares start trading. The coefficient of the range size is positive and significant for the four weeks volatility, suggesting that some of the initial uncertainty may still be present.

Since we found that oversubscription can predict aftermarket returns, in Table 9 we test whether demand from some bidders has more predictive power than demand from other bidders. We separate the oversubscription from different groups of bidders and find that the oversubscription due to large bids and frequent bidders predict aftermarket returns. These are the same bids that are used to set the issue price, suggesting that the investment banker only partially adjusts the issue price to reflect the demand from these bids. Oversubscription from small bids and infrequent bidders do not predict aftermarket returns. We also find that the oversubscription from late bidders is related to aftermarket returns, but oversubscription from early bidders is not. This contrasts with the results related to setting the issue price in which early oversubscription was more important than late oversubscription. The combination of these results suggests that the information in the early demand for shares is impounded in the issue price, but any late demand is not reflected in the

price until the shares start trading.

5.2. SEOs. We conduct a similar analysis for the aftermarket returns of seasoned issues. As explained above, in the case of SEOs the information available prior to the issue includes the premarket price. The investment banker, when choosing the issue price, deviates from the premarket price, on the basis of the information contained in the book. The first question is whether the aftermarket price returns to the level of the premarket price after the new shares are issued. This would tell us if the discount requested by the investors is reflecting information about the true value of the shares or if it is more a discount necessary to induce demand. In Table 10 the independent variables are the percentage difference between premarket price and issue price; the logarithm of the oversubscription; the percentage difference between average limit price and issue price; the standard deviation of limit prices; and the elasticity of the logarithm of the demand. We also use as an explanatory variable the volatility of the price in the month before the start of the bookbuilding. The only variable that is consistently related to aftermarket returns is the percentage difference between market price and issue price. For almost all of the regressions, the coefficient is significantly different from zero, but not significantly different from one suggesting that when the issue is priced at a discount, the market price reverts back to a level close to the premarket price.

This result is consistent with Smith (1977) who shows that the offer price, in fixed price offerings, is below both the market price before and after the new issue. These results can be explained by Parsons and Raviv (1985) who model seasoned offerings and assume the presence of investors with different valuations for the firm. The offer price is chosen sufficiently low so as to encourage high valuation investors to purchase shares at the offering rather than attempt to buy at a subsequently lowered price. In the context of bookbuilding, where the investment bank consults the investors before choosing the price, our results show that the investment banker looks at investors' reservation price, in order to determine an issue price at which they will be able to place the shares.

We find no evidence that the aftermarket returns can be predicted by oversubscription. There are mixed results regarding the effect of the degree of consensus among bidders. Elasticity is significantly related to aftermarket returns, but the standard deviation of limit prices is not statistically significant. The coefficient of the pre-issue volatility is positive but non significant.

In Table 11 we separate the oversubscription into different groups and we find that the oversubscription from large bids, oversubscription from frequent bidders and oversubscription from late bidders can predict aftermarket returns.

6. Conclusions

We examine the books of bids compiled by a large investment bank prior to equity issues. We find that there is a very strong relationship between the limit prices submitted by bidders and the issue price for both IPOs and SEOs. The relationship is primarily due to limit prices from certain subsets of bidders. The level of oversubscription has a smaller but significant effect on the issue price for IPOs. We do not find that oversubscription is related to SEO prices. These results support the hypothesis that the investment banker extracts pricing information from investors through the bookbuilding process. This is even true for seasoned offerings when there is a premarket price. In both IPOs and SEOs, the most informative bids are large bids and those coming from frequent investors.

We also find a positive relationship between oversubscription and aftermarket returns in IPOs. We interpret this as the investment banker only partially accounting for the oversubscription when setting the issue price. We also find that elasticity of the demand (i.e. consensus among bidders) is positively related to aftermarket returns and negatively related to the aftermarket volatility.

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

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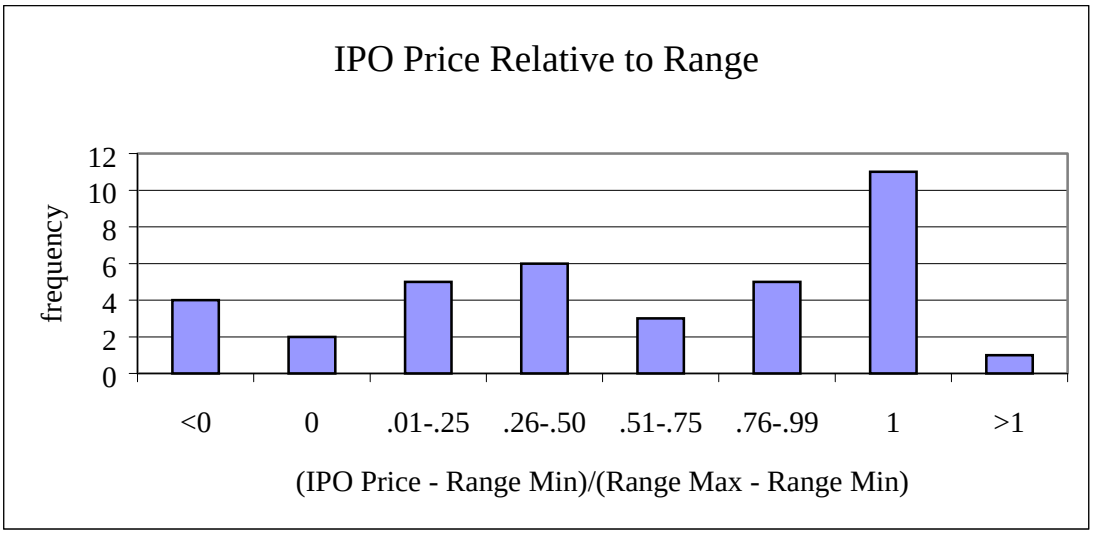
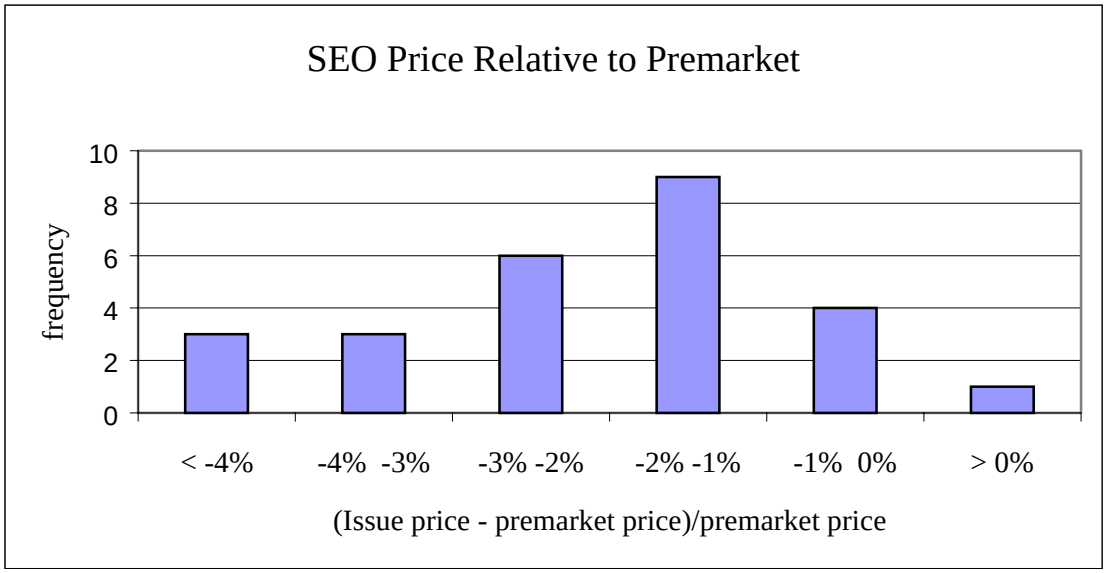
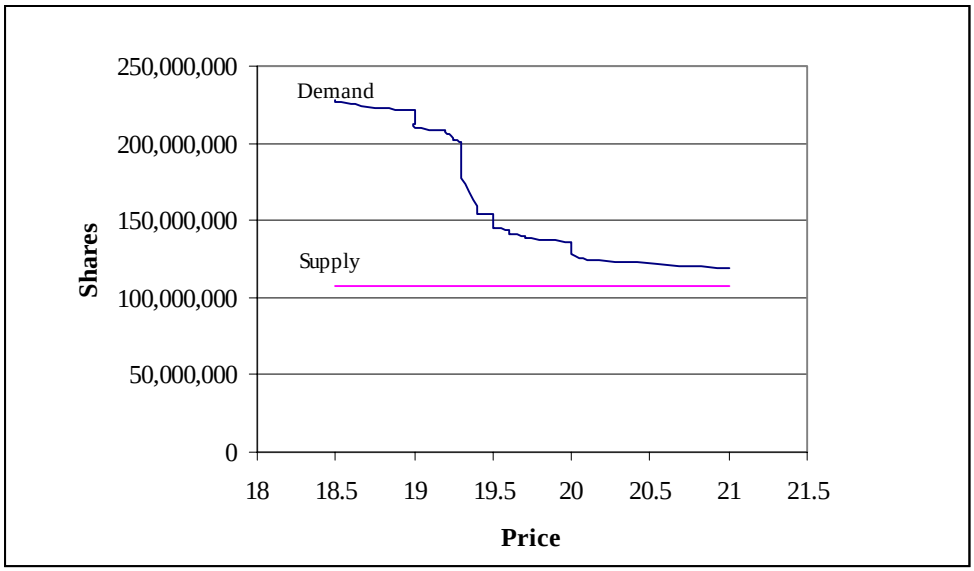
Figure 1: Issue Price





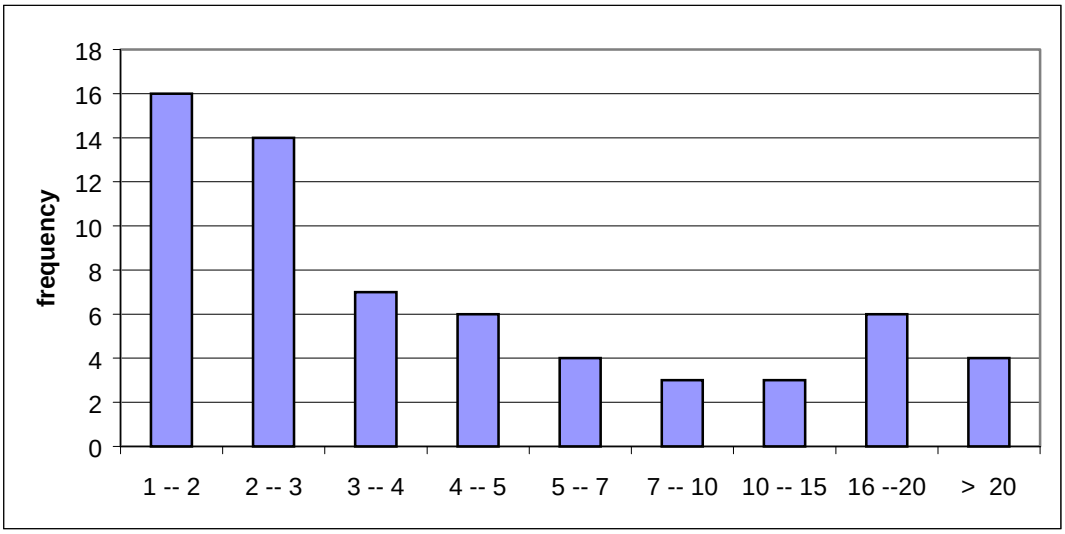
The first histogram shows the issue prices of IPOs, normalized relative to the initial price range. The average is 50%. The second histogram shows the issue price in seasoned issues, normalized relative to the premarket price. The average discount is 2.2%.

Figure 2: Example of Supply and Demand Curves



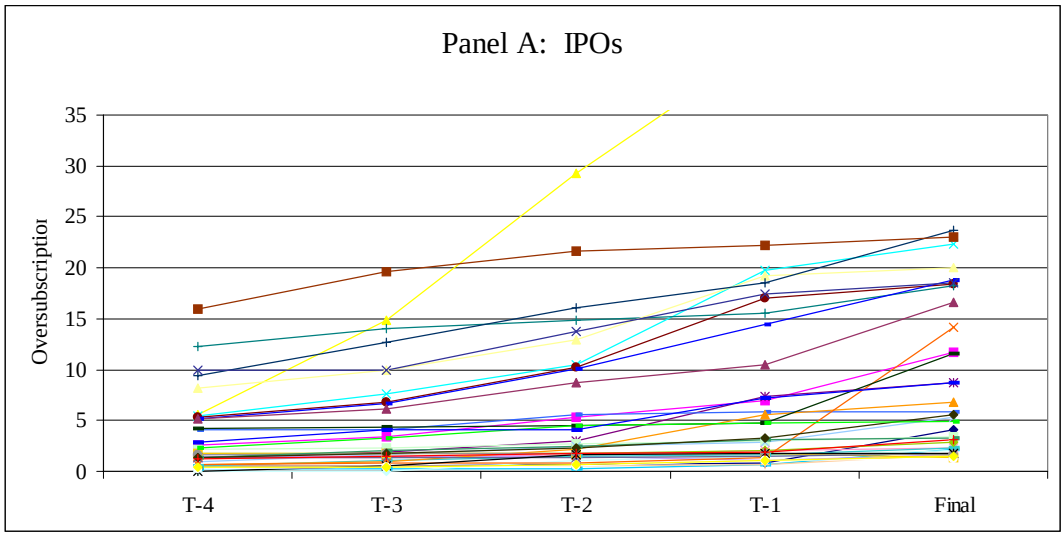
This figure shows the demand and supply curves (in shares) for a single issue. Stated demand is larger than the supply over the entire price range.

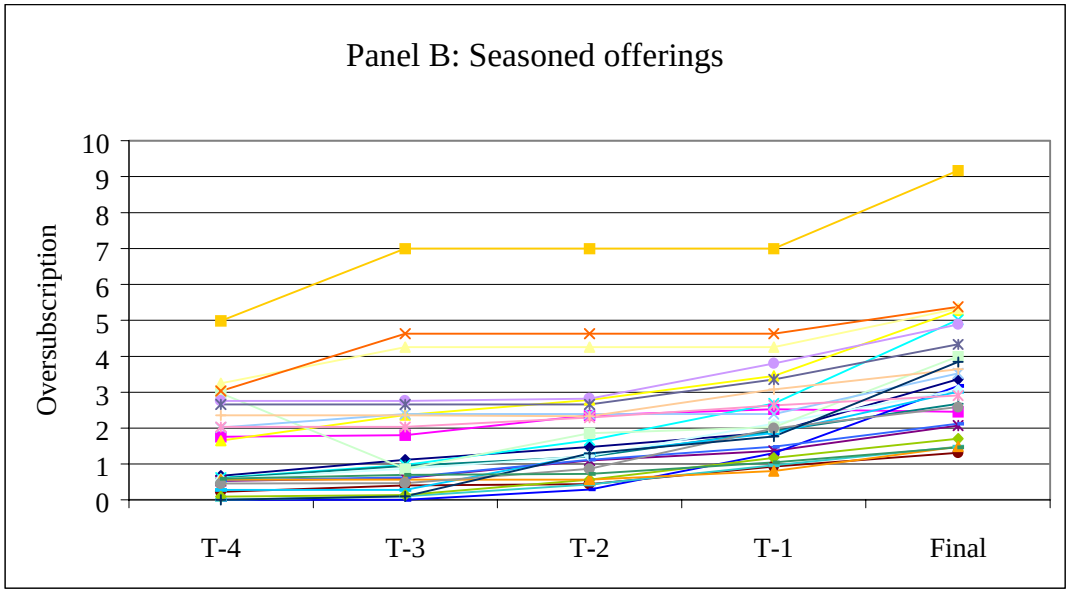
Figure 3: Oversubscription



This histogram displays the oversubscription, computed at the issue price, of the 63 equity issues in the sample. Oversubscription is defined as the sum of all bids (in shares) divided by the sum of shares allocated. The average oversubscription is 6.6 and the median is 3.0.

Figure 4: Evolution of the Book





These figures show the oversubscription of each issue over the time period starting from 4 days prior to the closure of the book until the book is finalized.

Table 1 (Panel A) : The choice of the issue price (IPOs)

The dependent variable in these regressions is the IPO price normalized by the initial price range. The average limit price is calculated as the quantity weighted average of all limit prices and is also normalized by the initial price range. Oversubscription is captured by the logarithm of 1 + total demand/supply of shares, where demand is measured at various prices. The standard deviation of limit prices is weighted by demand. Elasticity of the logarithm of demand is computed from the average limit price to a point 1% above. The *t*-statistics are in parentheses and are adjusted for heteroskedasticity using White's (1980) variance-covariance matrix.

										excluding range endpoints	only range interior
	Reg 1	**Reg 2**	**Reg 3**	**Reg 4**	**Reg 5**	**Reg 6**	**Reg 7**	**Reg 8**	**Reg 9**	**Reg 10**	**Reg 11**	**Reg 12**
Intercept	-0.06 (-0.9)	-0.31 (-1.3)	-0.34 (-4.0)	-0.26 (-3.6)	-0.24 (-3.6)	-0.12 (-1.1)	-1.00 (-3.8)	-0.33 (-4.7)	-0.35 (-3.9)	-0.35 (-4.0)	-0.30 (-3.5)	-0.22 (-3.5)
Average Limit Price	1.12 (13.3)		0.96 (11.0)	0.97 (12.2)	0.97 (10.2)	1.10 (13.0)	0.94 (12.8)	0.96 (14.3)	0.95 (11.3)		1.05 (13.3)	0.90 (6.7)
Oversubscription (all bids)		0.41 (4.5)	0.18 (4.0)					0.19 (3.9)	0.19 (4.0)	0.19 (4.0)	0.11 (3.9)	0.12 (3.1)
Oversubscription (at issue price)				0.16 (4.1)								
Oversubscription (strike bids)					0.15 (3.9)							
Oversubscription (limit and step bids)						0.07 (0.8)						
Number of bids (logarithm)							0.16 (3.5)					
Oversubscription per bid							4.89 (2.3)					
Standard Deviation of Limit Prices								-0.45 (-0.3)				
Elasticity (at the average limit price)									0.02 (0.5)			
Average Limit Price (privatizations)										0.92 (7.8)		
Average Limit Price (non privatizations)										0.97 (10.3)		
Adjusted R-squared	81.5%	37.5%	87.3%	87.6%	87.4%	81.3%	86.5%	85.4%	87.0%	87.0%	93.7%	81.9%
N	35	37	35	35	35	35	35	34	35	35	23	18

Table 1 (Panel B): The choice of the issue price (IPOs)

These regressions use a number of variations of the dependent variable to capture the effects of the average limit price, oversubscription, elasticity and the initial price range on the IPO price. The average limit price is calculated as the quantity weighted average of all limit prices (also normalized). Oversubscription is captured by the logarithm of 1 + total demand/supply of shares, where demand is measured at the lowest limit price (i.e., including missed limit bids). Elasticity is computed from the average limit price to a point 1% above. The range size is measured relative to its midpoint. The *t*-statistics are in parentheses and are adjusted for heteroskedasticity using White's (1980) variance-covariance matrix.

The dependent variable is the IPO issue price. In Regression 1 we use the alternative normalization relative to the midpoint of the range. In the normalization in Regression 2, the range is adjusted for market wide movements over the bookbuilding period. Regression 3 and 4 use the IPO price normalized by the range and by the range midpoint, respectively, as dependent variables. In Regression 5 the dependent variable is the percentage difference between the issue price and the average limit price. In Regression 6 the dependent variable is the absolute value of the percentage difference between the issue price and the average limit price.

	normalized relative to midpoint	market adjusted range	normalized relative to range	normalized relative to midpoint	issue price relative to average limit price	Absolute value of issue price relative to limit price
	Reg 1	**Reg 2**	**Reg 3**	**Reg 4**	**Reg 5**	**Reg 6**
Intercept	-0.02 (-0.3)	-0.35 (-4.3)	-0.24 (-1.9)	0.02 (0.3)	-0.05 (-2.0)	0.04 (1.9)
Average Limit Price	0.96 (14.3)	0.91 (12.0)	0.94 (9.8)	.94 (12.5)		
Oversubscription (all bids)	0.03 (4.0)	0.19 (4.5)	0.19 (4.0)	0.03 (4.1)	0.03 (3.8)	-0.01 (-1.0)
Elasticity (at the average limit price)					0.00 (1.0)	-0.01 (-2.4)
Range Size			-0.70 (-1.4)	-0.14 (-1.4)	-0.12 (-1.2)	0.07 (0.8)
Adjusted R-squared	88.8%	89.7%	87.3%	89.0%	33.7%	2.2%
N	35	35	35	35	35	35

Table 2: The choice of the issue price (SEOs)

The dependent variable in these regressions is the issue price normalized by the premarket price (except for Reg 9). The average limit price is calculated as the quantity weighted average of all limit prices and is also normalized by the initial price range. Oversubscription is captured by the logarithm of 1 + total demand/supply of shares, where demand is measured at various prices. The standard deviation of limit prices is weighted by demand. Elasticity is computed from the average limit price to a point 1% above. In Reg 9 the dependent variable is the absolute value of the percentage difference between the issue price and the average limit price. The *t*-statistics are in parentheses and are adjusted for heteroskedasticity using White's (1980) variance-covariance matrix.

	Reg 1	**Reg 2**	**Reg 3**	**Reg 4**	**Reg 5**	**Reg 6**	**Reg 7**	**Reg 8**	**Reg 9**
Intercept	-0.01 (-4.9)	-0.01 (-1.4)	-0.01 (-1.7)	-0.02 (-2.8)	-0.01 (-2.8)	-0.01 (-1.2)	-0.01 (-1.3)	-0.01 (-0.7)	0.01 (2.1)
Average Limit Price	0.59 (6.1)	0.59 (5.6)	0.59 (5.6)	0.58 (6.1)	0.58 (5.7)	0.58 (4.5)	0.58 (5.6)		
Oversubscription (all bids)		0.00 (0.1)				0.00 (0.1)	0.00 (0.1)	0.00 (-0.3)	0.00 (0.7)
Oversubscription (at issue price)			0.00 (-0.1)						
Oversubscription (strike bids)				0.00 (0.6)					
Oversubscription (limit and step bids)					0.00 (-0.2)				
Standard Deviation of Limit Prices						-0.17 (-0.2)			
Elasticity (at the average limit price)							-0.04 (-0.7)		-0.13 (-2.7)
Average Limit Price (privatizations)								0.38 (1.2)	
Average Limit Price (non privatizations)								0.61 (7.0)	
Adjusted R-squared	58.9%	57.1%	57.1%	57.8%	57.1%	55.2%	55.6%	56.4%	2.4%
N	26	26	26	26	26	26	26	26	26

Table 3: Influence of different types of investors

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, or in the case of SEOs normalized by the premarket stock price. The average limit price is weighted by the quantity demanded at each limit price and is also normalized. Oversubscription is captured by the logarithm of 1 + total demand/supply of shares where demand is measured at the lowest limit price. Large bids are those above the median quantity for each issue. Frequent bidders are those that participate in at least three issues. Early bids are those that were one of the first 25% received by the bookrunner. Favored bids are those that were awarded more shares (as a percentage of the bid quantity) than the median bidder. Three, two or one asterisks denote pairs of coefficients that are significantly different from each other at the 1%, 5% and 10% confidence levels, respectively.

Panel A: Limit prices of different types of Investors

	IPOs				Seasoned Issues			
	Reg 1	**Reg 2**	**Reg 3**	**Reg 4**	**Reg 5**	**Reg 6**	**Reg 7**	**Reg 8**
Intercept	-0.32	-0.26	-0.26	-0.41	-0.02	-0.02	-0.02	-0.02
	(-4.7)	(-3.1)	(-2.8)	(-5.1)	(-1.9)	(-1.7)	(-1.9)	(-2.2)
Oversubscription (all bids)	0.18	0.15	0.17	0.18	0.00	0.00	0.01	0.00
	(4.3)	(2.6)	(2.9)	(4.3)	(0.5)	(0.6)	(1.0)	(0.3)
Average Limit Price (Large bids)	1.14***				0.64*			
	(6.2)				(2.6)			
Average Limit Price (Small bids)	-0.20***				0.09*			
	(-1.2)				(0.9)			
Average Limit Price (Frequent bids)		1.25***				0.38		
		(4.8)				(2.2)		
Average Limit Price (Infrequent bidders)		-0.29***				0.40		
		(-1.3)				(5.0)		
Average Limit Price (Early bids)			0.07**				0.10	
			(0.4)				(1.2)	
Average Limit Price (Late bids)			0.78**				0.47	
			(4.8)				(1.7)	
Average Limit Price (Favored bids)				1.15**				0.75*
				(9.0)				(5.0)
Average Limit Price (Not favored bids)				-0.23**				-0.01*
				(-1.9)				(-0.1)
Adjusted R-squared	86.7%	86.0%	85.6%	89.1%	57.2%	59.4%	66.2%	64.3%
N	34	29	34	32	24	26	24	25

Panel B: Oversubscription of different types of Investors (IPOs)

	Reg 9	**Reg 10**	**Reg 11**	**Reg 12**
Intercept	-0.38	-0.29	-0.29	-0.27
	(-3.3)	(-3.7)	(-3.9)	(-3.5)
Average Limit Price	0.96	0.98	0.94	0.93
	(11.3)	(10.9)	(10.4)	(11.1)
Oversubscription (Large bids)	0.24			
	(2.7)			
Oversubscription (Small bids)	-0.13			
	(-0.7)			
Oversubscription (Frequent bidders)		0.15		
		(2.8)		
Oversubscription (Infrequent bidders)		0.05		
		(0.5)		
Oversubscription (Early Bids)			0.21	
			(2.4)	
Oversubscription (Late Bids)			0.03	
			(0.5)	
Oversubscription (Favored bids)				0.01
				(0.2)
Oversubscription (Not favored bids)				0.25
				(2.9)
Adjusted R-squared	87.0%	86.3%	87.2%	84.9%
N	35	35	35	35

Table 4: The evolution of the book (IPOs): How early limit prices influence the issue price

This table reports regression coefficients (and heteroskedasticity adjusted *t*-statistics in parentheses) for various model specifications. The dependent variable in all cases is the issue price normalized by the initial price range. The average limit price is calculated as the quantity weighted average of all limit prices and is also normalized by the initial price range. Oversubscription is captured by the logarithm of 1 + total demand/supply of shares where demand is measured at the lowest limit price. Regressions 1 through 5 consider the average limit price bid up until the specified number of days before the book closed. Regressions 6 through 10 consider the average of limit prices submitted on a single day only.

	Average limit price of all bids until day T-I				
	Reg 1	**Reg 2**	**Reg 3**	**Reg 4**	**Reg 5**
Intercept	-0.34 (-4.0)	-0.49 (-3.4)	-0.50 (-3.3)	-0.54 (-3.3)	-0.58 (-3.0)
Oversubscription (all bids)	0.18 (4.0)	0.27 (4.4)	0.30 (4.6)	0.33 (5.6)	0.42 (6.3)
Average Limit Price:					
Entire book	0.96 (11.0)				
until day T - 1		0.90 (8.9)			
until day T - 2			0.84 (6.8)		
until day T - 3				0.86 (5.2)	
until day T - 4					0.51 (2.8)
Adjusted R-squared	87.3%	74.8%	70.5%	68.1%	63.6%
N	35	35	35	34	33

	Average limit price of bids submitted on day T-I only				
	Reg 6	**Reg 7**	**Reg 8**	**Reg 9**	**Reg 10**
Intercept	-0.32 (-4.2)	-0.43 (-3.5)	-0.49 (-2.7)	-0.27 (-1.6)	-0.37 (-6.7)
Oversubscription (all bids)	0.17 (5.7)	0.20 (4.9)	0.28 (3.9)	0.27 (5.1)	0.18 (6.1)
Average Limit Price:					
Last day	1.00 (13.5)				0.61 (4.8)
Day T-1		1.02 (8.7)			0.40 (2.0)
Day T-2			0.79 (5.2)		-0.03 (-0.2)
Day T-3				0.75 (3.5)	0.07 (0.5)
	92.6%	80.1%	66.4%	58.0%	90.8%
	29	33	29	25	21

Table 5: The evolution of the book (IPOs): How early limit prices influence the issue price

This table reports regression coefficients (and heteroskedasticity adjusted *t*-statistics in parentheses) for various model specifications. The dependent variable in all cases is the issue price normalized by the initial price range. The average limit price is calculated as the quantity weighted average of all limit prices and is also normalized by the initial price range. Oversubscription is captured by the logarithm of 1 + total demand/supply of shares where demand is measured at the lowest limit price. Regressions 1 through 5 consider the oversubscription defined by bids submitted up until the specified number of days before the book closed. Regressions 6 through 9 consider oversubscription defined by the quantity bid only on a single day.

	Oversubscription due to all bids until day T-I				
	Reg 1	**Reg 2**	**Reg 3**	**Reg 4**	**Reg 5**
Intercept	-0.34 (-4.0)	-0.28 (-3.8)	-0.25 (-3.4)	-0.22 (-3.0)	-0.20 (-2.7)
Average Limit Price	0.96 (11.0)	0.98 (10.4)	1.00 (10.6)	1.02 (10.0)	1.05 (10.6)
Oversubscription (all bids)					
Entire book	0.18 (4.0)				
until day T - 1		0.17 (3.6)			
until day T - 2			0.16 (3.4)		
until day T - 3				0.16 (3.0)	
until day T - 4					0.15 (2.5)
Adjusted R-squared	87.3%	86.2%	85.4%	84.8%	84.0%
N	35	35	35	35	35

	Oversubscription due to all bids only on day T-I				
	Reg 6	**Reg 7**	**Reg 8**	**Reg 9**	**Reg 10**
Intercept	-0.16 (-2.0)	-0.16 (-2.4)	-0.13 (-1.8)	-0.13 (-2.0)	-0.13 (-1.9)
Average Limit Price	1.08 (12.5)	1.04 (13.0)	1.04 (11.4)	1.02 (12.4)	1.01 (12.6)
Oversubscription (all bids)					
Last day	0.11 (2.1)				-0.03 (-0.4)
Day T-1		0.13 (2.6)			0.09 (1.0)
Day T-2			0.13 (2.1)		-0.04 (-0.4)
Day T-3				0.19 (2.5)	0.18 (1.7)
	84.0%	84.6%	83.3%	85.2%	84.2%
	35	35	35	35	35

Table 6: The evolution of the book (SEOs): How early limit prices influence the issue price

This table reports regression coefficients (and heteroskedasticity adjusted *t*-statistics in parentheses) for various model specifications. The dependent variable in all cases is the issue price normalized by the premarket price. The average limit price is calculated as the quantity weighted average of all limit prices and is also normalized by the premarket price. Oversubscription is captured by the logarithm of 1 + total demand/supply of shares where demand is measured at the lowest limit price. Regressions 1 through 5 consider the average limit price bid up until the specified number of days before the book closed. Regressions 6 through 10 consider the average of limit prices submitted on a single day only.

	Average limit price of all bids until day T-I				
	Reg 1	**Reg 2**	**Reg 3**	**Reg 4**	**Reg 5**
Intercept	-0.01 (-1.4)	-0.03 (-2.0)	-0.03 (-1.8)	-0.03 (-1.7)	-0.02 (-1.6)
Oversubscription (all bids)	0.00 (0.1)	0.01 (1.1)	0.01 (0.9)	0.01 (0.8)	0.01 (0.7)
Average limit price:					
Entire book	0.59 (5.6)				
until day T - 1		0.50 (4.1)			
until day T - 2			0.42 (3.1)		
until day T - 3				0.34 (1.9)	
until day T - 4					0.2 (6.8)
Adjusted R-squared	57.1%	39.8%	32.2%	11.7%	27.9%
N	26	26	26	23	22

	Average limit price of all bids only on day T-I				
	Reg 6	**Reg 7**	**Reg 8**	**Reg 9**	**Reg 10**
Intercept	-0.01 (-1.0)	-0.03 (-1.8)	-0.03 (-1.7)	-0.02 (-1.1)	-0.01 (-0.8)
Oversubscription (all bids)	0.00 (-0.3)	0.01 (1.0)	0.01 (0.9)	0.00 (-0.2)	0.01 (0.5)
Average limit price:					
Last day	0.58 (5.9)				1.06 (4.9)
Day T-1		0.49 (3.1)			0.63 (1.3)
Day T-2			0.43 (3.1)		-0.83 (-2.3)
Day T-3				0.09 (0.3)	0.00 (0.0)
	64.1%	33.2%	42.3%	-12.9%	65.2%
	26	21	18	16	12

Table 7: Aftermarket returns: IPOs

This table reports regression coefficients (and heteroskedasticity adjusted *t*-statistics in parentheses) for various model specifications. The dependent variable is the benchmarked one-day aftermarket return. The average limit price (and the standard deviation of limit prices) are quantity weighted. Oversubscription is captured by the logarithm of 1 + total demand/supply of shares where demand is measured at the lowest limit price. Elasticities are computed from the average limit price (or the issue price) to a point 1% above.

First day returns

	Reg 1	**Reg 2**	**Reg 3**	**Reg 4**	**Reg 5**	Only range interior **Reg 6**	Only low oversub. **Reg 7**	**Reg 8**	**Reg 9**	**Reg 10**
Intercept	0.02 (1.5)	-0.07 (-2.5)	-0.06 (-2.3)	0.06 (4.3)	-0.05 (-1.5)	-0.02 (-0.4)	0.01 (0.2)	-0.03 (-1.0)	-0.06 (-1.8)	-0.08 (-2.1)
Issue price (normalized)	0.07 (3.6)		0.02 (1.1)							
Oversubscription (all bids)		0.07 (4.3)	0.06 (3.4)		0.06 (3.4)	0.05 (2.7)	0.03 (0.8)	0.06 (3.8)	0.06 (3.5)	0.07 (3.7)
% difference between average limit price and issue price				-1.12 (-3.2)	-0.46 (-1.1)	-1.24 (-1.7)	-1.10 (-3.7)	-0.33 (-0.8)	-0.43 (-1.1)	-0.38 (-0.9)
Standard Deviation of Limit Prices								-0.48 (-2.2)		
Elasticity (at average limit price)									0.018 (1.4)	
Elasticity (at issue price)										0.013 (2.1)
Adjusted R-squared	18.7%	33.3%	32.5%	23.3%	36.6%	32.5%	34.9%	40.5%	36.3%	37.6%
N	36	36	36	34	34	18	21	33	34	34

Table 8: Effect of uncertainty on aftermarket returns and volatility (IPOs)

This table reports regression coefficients (and heteroskedasticity adjusted *t*-statistics in parentheses) for various model specifications. Elasticities are computed from the average limit price (or the issue price) to a point 1% above. The range size is relative to the midpoint of the initial price range. The dependent variable in Regs 1 and 2 is the absolute value of unexpected one-day returns, where expected returns are defined based on the estimates of Regression 3 in Table 7. The dependent variables in Regs 3 through 8 are the standard deviations of the returns in the aftermarket.

	Absolute value of unexpected one-day returns		**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	.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 (at the issue price)	-0.01		-0.03		-0.02		-0.03	
	(-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 9: Aftermarket returns by investors types: IPOs

This table reports regression coefficients (and heteroskedasticity adjusted *t*-statistics in parentheses) for various model specifications. The dependent variable is the benchmarked one-day returns. The average limit price (and the standard deviation of limit prices) are quantity weighted. Oversubscription is captured by the logarithm of 1 + total demand/supply of shares where demand is measured at the lowest limit price. Large bids are those above the median quantity for each issue. Frequent bidders are those that participate in at least three issues. Early bids are those that were one of the first 25% received by the bookrunner. Three, two or one asterisks denote pairs of coefficients that are different from each other at the 1%, 5% and 10% confidence levels respectively.

	Reg 1	**Reg 2**	**Reg 3**
Intercept	-0.05 (-1.7)	-0.10 (-2.6)	-0.02 (-0.7)
% difference between average limit price and issue price	-0.37 (-1.0)	-0.47 (-1.2)	-0.55 (-1.5)
Oversubscription from frequent bidders	0.08** (3.4)		
Oversubscription from infrequent bidders	-0.02** (-0.7)		
Oversubscription from large bids		0.13*** (3.6)	
Oversubscription from small bids		-0.20*** (-2.5)	
Oversubscription from early bids			-0.04** (-1.3)
Oversubscription from late bids			0.09** (3.3)
Adjusted R-squared	42.9%	43.6%	44.6%
N	34	34	34

Table 10: Aftermarket returns: Seasoned Issues

This table reports regression coefficients (and heteroskedasticity adjusted *t*-statistics in parentheses) for various model specifications. The dependent variable is the benchmarked one-day aftermarket returns. The average limit price (and the standard deviation of limit prices) are quantity weighted. Oversubscription is captured by the logarithm of 1 + total demand/supply of shares where demand is measured at the lowest limit price. The elasticity is computed from the issue price to a point 1% above. Pre-issue volatility is based on market prices for the one-month period prior to the start of bookbuilding process.

	One day returns					
	Reg 1	**Reg 2**	**Reg 3**	**Reg 4**	**Reg 5**	**Reg 6**
Intercept	0.01 (1.4)	-0.02 (-0.8)	0.02 (1.4)	-0.01 (-0.4)	-0.03 (-0.9)	-0.03 (-1.3)
% difference between pre-market price and issue price	1.10 (2.2)	1.06 (2.5)	1.06 (2.1)	1.00 (2.2)	0.96 (2.2)	0.93 (2.0)
Oversubscription		0.02 (1.2)		0.02 (1.2)	0.03 (1.3)	0.02 (0.9)
% difference between average limit price and issue price		0.19 (0.4)		0.24 (0.5)	0.31 (0.6)	0.03 (0.1)
Standard deviation of limit prices			-1.92 (-0.6)	-2.11 (-0.8)		
Elasticity (at the issue price)					0.002 (2.2)	
Pre-issue volatility						0.09 (1.7)
Adjusted R-squared	19.7%	19.6%	17.1%	17.0%	18.9%	25.8%
N	25	25	25	25	25	25

Table 11: Aftermarket returns by investors types: SEOs

This table reports regression coefficients (and heteroskedasticity adjusted *t*-statistics in parentheses) for various model specifications. The dependent variable is the benchmarked one-day aftermarket returns. The average limit price (and the standard deviation of limit prices) are quantity weighted. Oversubscription is captured by the logarithm of 1 + total demand/supply of shares where demand is measured at the lowest limit price. Large bids are those above the median quantity for each issue. Frequent bidders are those that participate in at least three issues. Early bids are those that were one of the first 25% received by the bookrunner. Three, two or one asterisks denote pairs of coefficients that are different from each other at the 1%, 5% and 10% confidence levels respectively.

	One day returns		
	Reg 1	**Reg 2**	**Reg 3**
Intercept	-0.04	-0.04	-0.01
	(-2.3)	(-1.9)	(-0.6)
% difference between market price and issue price	1.20	0.99	1.04
	(3.6)	(2.4)	(3.0)
% difference between average limit price and issue price	0.09	0.18	0.23
	(0.2)	(0.4)	(0.5)
Oversubscription from frequent bidders	0.06***		
	(5.0)		
Oversubscription from infrequent bidders	-0.04***		
	(-2.3)		
Oversubscription from large bids		0.06**	
		(2.7)	
Oversubscription from small bids		-0.12**	
		(-1.7)	
Oversubscription from early bids			-0.02
			(-0.7)
Oversubscription from late bids			0.04
			(2.2)
Adjusted R-squared	39.1%	28.2%	20.3%
N	25	25	25