Bookbuilding and Strategic Allocation*

Francesca Cornelli and David Goldreich

This Version: January, 2001

Abstract

In the bookbuilding procedure, an investment banker solicits bids for shares from institutional investors prior to pricing an equity issue. The banker then prices the issue and allocates shares at his discretion to the investors. We examine the books for 39 international equity issues. We find that the investment banker awards more shares to bidders who provide information in their bids. Regular investors receive favorable allocations, especially when the issue is heavily oversubscribed. The investment banker also favors revised bids and domestic investors.

*Cornelli is at the Fuqua School of Business, Duke University, the London Business School, and CEPR. Goldreich is at the London Business School. We are grateful to Alon Brav, Ian Cooper, Leonardo Felli, Julian Franks, Larry Glosten, Kathleen Hanley, Campbell Harvey, Ravi Jagannathan, Matti Keloharju, Alexander Ljungqvist, Ernst Maug, Roni Michaely, Clara Raposo, Barbara Rindi, Jay Ritter, Kristian Rydqvist, Henri Servaes, René Stulz (the editor), Ivo Welch, Avi Wohl, Luigi Zingales, and two anonymous referees for insightful comments and to seminar participants at Aarhus University, Cornell University, Duke University, European University Institute, HEC, INSEAD, London Business School, London School of Economics, Northwestern University, NYSE, Rutgers University, Stanford University, Tulane University, University of Chicago, University of Georgia, University of Michigan, University of North Carolina-Chapel Hill, Universitá di Salerno, University of Utah, the Wharton School, the 1999 Finance Summer Symposium in Gerzensee and the 1999 WFA meetings. We also thank Sebastian de Ramon, Burcin Kasapoglu, Farshad Mashayekhi and Lakshman Easwaran for excellent research assistance and Sandra Moore for editing the text. We give particular thanks to the investment banker who supplied us with the data. Part of this research was done while Cornelli was visiting the Wharton School, whose generous hospitality is gratefully acknowledged. The project was supported by an LBS and a CIBER Research Grant.

Investment banks commonly "build a book" before pricing an equity issue. In the U.S. it has been standard practice for a number of years. In many other countries where fixed-price offerings were traditionally used, the bookbuilding procedure is becoming increasingly common, especially for international equity issues.[1]

Under the formal bookbuilding procedure, the investment banker solicits indications of interest from institutional investors. Such indications consist of a bid for a quantity of shares and might include a maximum price (i.e., a limit price) or other details. The investment banker uses the information to construct a demand curve. The issue price is not set according to any explicit rule, but rather based on the banker's interpretation of investors' indications of interest. He generally sets the price at a level at which demand exceeds supply, and then allocates shares to the bidders at his discretion. Thus, the bookbuilding procedure resembles an auction, but there are some important differences. The most important difference is that the pricing and allocation rules are not announced, but are left to the discretion of the investment banker. Another difference is that investors' bids do not represent a commitment, but merely an indication of interest. However, because of the repeated nature of the relationship, it is very rare for any investor to renege on a bid.

Much of the theoretical literature (see in particular Benveniste and Spindt, 1989 and Spatt and Srivastava, 1991) argues that bookbuilding allows the investment banker to collect information about the value of the stock and price the issue more accurately. To compensate the investors who reveal information, the investment bank will favor them when allocating shares. This argument is consistent with the international evidence, which shows that countries that use bookbuilding typically have less underpricing than countries using fixed-price offerings (see Ritter, 1998, and Loughran, Ritter, and Rydqvist, 1994).

Benveniste and Spindt (1989) also argue that by not announcing the allocation rule, the investment banker can use his discretion to reward regular investors, who act as a form of insurance by buying shares in both badly received and well received issues.

In this paper we study a unique data set that comprises the books of 39 inter-

[1]See Benveniste and Wilhelm (1997), Ritter (1998), and Sherman (1999).

national equity issues. These books include all the bid details and the allocations to each institutional investor. To our knowledge, we are the first to have all requests and discretionary allocations. Using these books allows us to learn about the role of bookbuilding, to analyze the allocation decision of the investment bank and to test theories about bookbuilding and equity offerings in general.[2]

Because of our detailed bid data, we can look more closely at whether bidders who reveal information are favored when the investment banker allocates shares. For example, we consider whether or not a bid includes a maximum price limit. If none of the bidders includes a limit price, the only information the investment banker can use to set the price of the issue is the number of shares demanded. The presence of limit prices provides additional information that tells him how demand varies within the preannounced price range.

We find that the investment banker awards more shares to bidders who reveal information through limit prices than he does to similar bidders who submit quantity bids without price limits. Similarly, bidders who revise their bids—which can be interpreted as providing information as it arises over time—receive more favorable treatment in the allocation of shares.

We also find that bidders who participate in a large number of issues receive favorable treatment, especially for the more successful (i.e., oversubscribed) issues. Although these investors are favored in terms of shares when the issue seems likely to be successful, we do not find evidence that they earn profits beyond those earned by other investors. This finding is consistent with the argument that such investors are being compensated for the insurance they provide.

We also look at whether the investment banker pursues other objectives. For example, to increase liquidity and avoid the creation of large blocks, the issuer might want to favor small shareholders. We find evidence that the opposite is true. In the case of international equity issues that are placed simultaneously in many different countries, the issuer or the investment banker may prefer foreign or domestic investors. We find domestic investors are favored. We also find that the investment banker

[2]For an overview of these theories and their empirical implications, see Jenkinson and Ljungqvist (1996) and Ibbotson, Sindelar, and Ritter (1994).

favors insurance companies and pension funds, which are usually considered long-term investors.

Finally, there is one dimension in which the investment bank seems to maximize its own interest rather than the client's. We find that the investment bank uses its discretion to increase its own compensation by favoring bids that are submitted directly to the bookrunner rather than to other members of the selling syndicate. In such case, the bookrunner receives the broker's fee.

In this paper, we observe the book and the entire demand for stock over a range of prices. Kandel, Sarig, and Wohl (1999) and Biais and Faugeron-Crouzet (1999) also study equity issues and observe the entire demand for the shares. However, in those studies, the shares are sold through an auction or an auction-like mechanism, in which the allocation rule is specified in advance. In our study, the allocation is completely discretionary, and we use the data to determine the investment banker's allocation criteria.

Both Keloharju (1998) and Lee, Taylor, and Walter (1999) study share allocations in equity offerings to identify informed investors. However, they study procedures where bids are not used to price the issue and information extraction is not relevant. In bookbuilding, the information contained in the bids is used to price the issue; consequently, investors lose their informational advantage.

In the next section, we discuss the bookbuilding process, and provide some descriptive statistics. Section II discusses the testable implications of the theoretical literature. Section III contains the empirical analysis of the allocation decisions. Section IV concludes.

I. Description of the Data and the Bookbuilding Procedure

We study 39 equity issues that took place between 1995 and 1997. The issuing companies come from 20 different countries and many different industries. Bidders come from 60 different countries throughout Europe, North and South America, Asia, and Australia. A leading European investment bank with an international presence was the global bookrunner for all issues. This investment bank can easily market shares in many countries, including the U.S.[3]

Of the 39 issues, 23 are initial public offerings (IPOs) and 16 are seasoned equity offerings (SEOs). Although there was a prior market price for SEOs, the bookbuilding procedure was used nonetheless, because either the existing stock was illiquid or the quantity of new shares was considered large enough, relative to the shares already trading, to move the market. Thus, we do not consider these SEOs as substantially different from IPOs and include them in our study. Fourteen of the 39 issues are privatizations (both IPOs and later tranches). We include privatizations because the bidders are primarily foreign institutions, and we have no reason to believe that the criteria for allocating shares to these investors should be different than in other issues.[4] Huang and Levich (1998) provide evidence that supports an objective of proceeds maximization in privatization IPOs.

On average, we find that the issues are underpriced by 3.4% relative to the first available post-issue market price. The average for the entire sample is significantly different from zero at the 1% level. The value-weighted average underpricing is 3.9%. The weighted average for IPOs is 3.7% and for SEOs is 4.3%.[5] Table I provides summary statistics for the 39 issues.

The procedure for bringing an issue to market is similar for both international and domestic offers. For international issues, underwriters from different countries take part in the syndicate, but at the end of the bookbuilding period the demand from all institutional investors is aggregated into a single book in the global bookrunner's hands. Shares are placed simultaneously in all different countries at the same offer price.

The bookbuilding process begins with the investment bank announcing a price range. This range is only indicative, and for three issues in our sample the price is set outside of the initial price range.[6] The book contains each bid submitted, and identifies the bidder, the number of shares requested, and a limit price if the bidder

[3]In two issues there were global co-bookrunners: both major U.S. investment banks.

[4]In these privatizations, shares for domestic retail customers were typically sold in a separate tranche at a preannounced discount to the general issue price.

[5]This average return for seasoned offerings is influenced by a single outlier. The weighted average underpricing for SEOs excluding the outlying issue is 3.8%.

[6]Jenkinson, Ljungqvist and Wilhelm (2000) show that when the bookrunner is a non-U.S. underwriter, shares are priced outside of the initial price range much less frequently than in the U.S.

specifies one. The book also records the date the bid was entered and any subsequent revisions (or cancellation) of the bid and it identifies the member of the syndicate that acted as the manager receiving the bid. For each issue we have data on all the bids from institutional buyers and their share allocations.[7]

The book distinguishes between three types of bids. A "strike bid" is a request for shares regardless of the issue price. A "limit bid" specifies the maximum price that the bidder is willing to pay for the shares. In a "step bid," the bidder submits a demand schedule as a step function. Any of these bids can be for a specified quantity of shares or for a given amount of money, regardless of the issue price. We use the term "currency bids" to define those bids that specify an amount of money, rather than a fixed number of shares.

As an example, Table II shows 11 bids from an actual issue. The first bidder expresses an interest in purchasing £1 million worth of shares. The bid is a strike bid — he is willing to pay any issue price. However, because the bid is expressed in currency units rather than shares, his demand for shares is lower at higher prices. In contrast, the last four bidders asked for 20,000 shares regardless of the price. Bidder 7 submits the only limit order in this part of the book. This bidder requests 20,000 shares at a maximum price of 72. Bidder 5 submits a step bid, specifying 10,000 shares for a price of 69 or lower, but only 5000 shares for a price above 69, and an absolute price limit of 75. Bidder 4 revises his bid twice.

The average number of final bids per issue is 295 (excluding cancelled bids). The actual number of final bids ranges from 57 to 896. Bidders revise 16% of all bids and ultimately cancel 4.6% of all initial bids.

Eighty percent of all final bids are strike bids, 16.6% are limit bids, and 3.4% are step bids. Moreover, 37% of all bids are currency bids. In general, individual bidders do not always bid the same way: Bidders frequently switch between strike and limit bids from one issue to the next. Of all limit bids, 21.5% were missed, because the issue price was higher than the limit price. Of the step bids, 9.8% were missed, because the issue price was above all of the steps.

[7]The book does not include the retail demand. In some issues, the investment banker reserves a prespecified number of shares for retail investors. Their demand is handled separately and is not used to price the issue.

There are 6,236 unique bidders in the data set. Although the majority of the bidders bid only once or a few times, more than 100 bidders take part in at least ten issues: 16.8% of the bids come from investors who bid at least ten times.

After the deadline for submitting bids, the investment banker aggregates all of the bid information and determines the issue price. The price is set so that total demand is larger than the number of shares offered. Figure 1 shows the oversubscription at the issue price for the issues in our sample. The median oversubscription corresponds to a total demand of approximately three times the total supply. However, there are some very heavily oversubscribed issues, up to 22 times the number of shares offered.

Figure 2 shows the demand and supply curves for one issue. In total, just under 1.5 million shares were issued. However, even at a price of 80, the bids totalled more than 2.2 million shares. The issue price was set at 71, nowhere near where the supply and the demand curves cross. Instead, the price is set near the point where the demand curve begins its steepest descent.

Once the issue price is set, the investment banker decides how to allocate the total shares among investors. As explained earlier, he does not follow an explicit rule. Table II includes the allocations for a sample of bids. If we look at the last five bids, we see that the banker is not following a strict priority rule. In fact, all these bids request the same number of shares, but the limit bid is awarded shares even though the strike bids have not received a 100% allocation. It is also noteworthy that the bidders are not being rationed equally. The awards to these bidders range from 5,000 shares to 12,200 shares, even though they all requested the same number of shares.

Many investors get no shares. On average, 30% of the bidders in each issue were not allocated shares. Only a very small percentage of bidders in each issue (3.6%) are awarded the entire quantity of shares requested.

Because the nominal value of each share varies across issues, we do not focus on quantities of shares directly. Instead, when considering each bid, we look at the *percentage bid,* which we define as the quantity of each bid as a percentage of the total demand for shares in the issue (at the issue price). We also consider the *percentage allocation*, which we define as the allocation to a bidder as a percentage of the total supply of shares to be allocated in the issue.

As an example, suppose there are one million shares available and that total demand is two million shares (i.e., oversubscription is equal to two). Suppose that Bidder A bids for 1,000 shares and receives 600 shares. Bidder B requests 2,000 shares and receives 800 shares. Bidder A's bid represents 0.05% of the demand for the shares and he is awarded 0.06% of the supply. Bidder B has a percentage bid of 0.1% and a percentage allocation of 0.08%.

We define *rationing* as the number of shares allocated to a bidder divided by the number of shares he requests. However, we do not emphasize this raw measure of rationing when we compare bids, because it will naturally be lower in heavily oversubscribed issues than it will be in issues with little oversubscription. The focus of our analysis is instead on the *normalized rationing*, which we define as the ratio of percentage allocation to percentage bid. (Normalized rationing is also equal to raw rationing times the oversubscription.) If the investment bank allocates shares on a pro rata basis, then all bids will have normalized rationing of 100%. Any deviation in the normalized rationing above or below 100% represents discrimination either in favor of or against some bidders.

In the previous example, Bidder A has (raw) rationing of 60% and Bidder B of 40%. The normalized rationing of Bidders A and B are 120% and 80%, respectively. This indicates that Bidder A is awarded 20% more shares than he would have received under a pro rata scheme, and Bidder B is awarded 20% less than pro rata. If we change the example so that the total demand doubles and oversubscription is equal to four (but assuming that the bids and allocations of Bidders A and B remain unchanged), then the normalized rationing for the two bidders would double to 240% and 160%, because they would each be getting far in excess of pro rata.

The average raw rationing in our sample is 28.5%. The average normalized rationing is 71.8%.

II. Theories and Testable Implications

As we noted in the Introduction, bookbuilding has become increasingly common in recent years. Several theories have been trying to answer the question of whether building a book is merely a good way to keep track of the clients' requests, or whether it is part of a mechanism designed to improve the pricing and allocation of the issue.

In this section we present several theories which can help us understand the purpose of the book and their empirical implications.

Several theories argue that building a book allows the underwriter to extract important information. These theories assume that there is an underlying problem of information asymmetry that can be reduced with the intelligent use of the book. The winner's curse model proposed by Rock (1986) shows that when equity is issued through a fixed price offering, underpricing occurs due to the presence of informed investors. If informed investors only buy underpriced issues, uninformed investors obtain more shares in overpriced issues than in underpriced issues and will only demand shares if they are underpriced on average.[8]

Benveniste and Spindt (1989), Benveniste and Wilhelm (1990), and Spatt and Srivastava (1991) argue that the purpose of bookbuilding is to extract information from informed investors, giving some rents in exchange for truthful revelation. The investment banker uses the information conveyed to price the issue more accurately. Therefore, if the investment bank can allocate more shares to those bidders who provide valuable information, less underpricing is required.

When testing these theories, the major challenge is how to identify the informed bidders. Some empirical studies use institutional investors as a proxy for informed investors. However, Hanley and Wilhelm (1995) find that there is no difference in the size of the allocations institutional investors receive in underpriced and overpriced issues. On the other hand, only institutional investors participate in the bookbuilding procedure.[9] Within the book, some investors might be more informed than others, and some might have information about some issues but not others. The strength of our data lies in the fact that we can infer investors' information from the character-

[8]In fact, we can check that if the equity issues in our sample had been sold through fixed-price offerings, uninformed investors would have faced adverse selection and would therefore have chosen not to participate. We assume that in a fixed-price offering the issue price will be set equal to the midpoint of the initial price range and that an uninformed investor would bid \$1 in each issue. If we use the actual aggregate demand curves from our data set and assume pro rata allocations, the uninformed investor will suffer a loss of 3.36%. Therefore, he will not buy shares.

[9]Benveniste and Wilhelm (1990) and Sherman and Titman (1999) argue that underwriters decide to restrict the book to a group of institutional investors because they wish to provide such investors with the incentives to collect costly information. Maksimovic and Pichler (1999) show that it is optimal to form a pool of informed investors to whom to give special access but to retain the option to sell to the general public.

istics of each bid.

In the bookbuilding procedure, investors not only ask for larger or smaller quantities, but also submit bids in the form of strike, limit, or step bids. When an informed investor submits a limit bid, he reveals his information. In fact, if all bids were strike bids for fixed quantities of shares, the aggregate demand would be perfectly inelastic and the book would provide no indication on how to price the issue, other than through the overall level of demand. In contrast, limit bids provide specific information about the elasticity of the demand and give the underwriter a better idea of where to price the issue within the price range. In exchange for revealing information, the investor receives more (underpriced) shares.

Now we consider why an uninformed investor would not want to submit a limit bid. By submitting a limit bid, he incurs two types of costs: If the limit price is too low, the investment bank might set the issue price higher than the limit price and the investor would obtain no shares. But if the investor's limit price is too high, he might influence the price upwards and receive overpriced shares.

Since limit and step bids can be considered "lower" bids than strike bids and under strict priority would be discriminated against, a testable implication of the information extraction theory is that limit and step bids should be treated more favorably in the allocation of shares.

One might wonder why the investment banker needs to collect information, since he would have already produced detailed forecasts of the firm's future cash flows. However, the information could also include the market's beliefs, or, if the demand is downward sloping, the elasticity of the demand. For our purposes, it is only important for investors to have some information that is relevant for pricing the issue. Cornelli and Goldreich (2000) study the choice of the issue price and show that limit prices provide information that is important in determining the issue price. In this paper, we study whether the investment banker favors investors who use limit bids. If he does, this would indicate that he rewards bidders who provide information that is actively used in setting the issue price.

Another testable implication relates to frequent investors. The IPO literature (for example, Beatty and Ritter, 1986) emphasizes that an implication of the winner's

curse is that riskier offerings are more underpriced. Therefore, by pooling offerings the underwriter can reduce average underpricing. Benveniste and Spindt (1989) argue that discretion is left to the investment banker precisely to enable him to pool the issues. He does so by discriminating in the allocation of shares based on investors' participation in past offerings. Frequent buyers act as insurance and buy shares in both successful and unsuccessful issues. As compensation, the investment banker should favor regular investors who participate in many issues. Moreover, frequent investors, despite the favorable treatment in the number of shares allocated, should not earn higher returns than other investors, since they are only being compensated for buying less successful issues.

Another way to mitigate the winner's curse is to create informational cascades (Welch, 1992): The investment banker might attempt to encourage early demand for shares by informed investors, since this will induce other investors to follow. Usually, the book is kept confidential, but the investment banker can still hint to investors that demand for the shares is already high, allowing a cascade to form.[10] Alternatively, to refine the process of soliciting bids over time, the investment banker might want to collect information early. To encourage early demand, the investment banker may give larger allocations to early bids.

In the share allocation decision, the investment bank may also have other concerns. For example, the issuing company may have preferences over the ownership distribution of its shares. Brennan and Franks (1997) argue that managers want to avoid having any single investor accumulate a large stake. The issuing company might also want to spread ownership widely to increase liquidity. The implication in both cases is that rationing should favor investors who demand a smaller number of shares.

Another criterion that might influence share allocation is the nationality of the bidder. The issuer or the investment bank might prefer investors from the issuing firm's country. The objective of extracting information implies favorable treatment for domestic investors, since they may be better informed about the issuing company.[11] Alternatively, as noted in Chaplinsky and Ramchand (2000), to lower its cost

[10]Benveniste and Busaba (1997) argue that bookbuilding can be seen as an alternative to creating a cascade.

[11]The "home-bias" effect is attributed in part to information costs. Even if institutional domestic

of capital, the issuer might want to create an international body of shareholders and broaden its shareholder base. However, Karolyi (1999) cites instances in which, following an international equity issue, most of the shares placed abroad migrated back to resident investors. The investment bank might want to avoid this phenomenon by placing the issue directly into the hands of domestic investors.

Finally, the investment bank could simply pursue its own interests. For example, the bank can increase its own compensation by favoring investors who submit their bids directly to the bookrunner, since the bank then earns additional selling fees. The bank can also serve its own interests in a more indirect way, by favoring its "friends," who in return can help the bank in other circumstances.

III. Empirical Results

Once the issue price has been chosen, the underwriter calculates the total oversubscription of the issue and decides how to allocate the shares among the bidders. We assume that share distribution does not influence the pricing decision. For example, we exclude the possibility that the investment banker would set a low price to ensure that a particular limit order is hit. Therefore, we study the share allocations given the demand at the issue price.

For all the analysis in the paper, we obtain our results by equally weighting each issue. We have repeated the analysis with equal weight for each bid, and found similar results.

Table III shows the average bid as a percentage of total demand, the average allocation size as a percentage of total number of shares offered, the average rationing, and the average normalized rationing when bids are broken up according to different criteria.[12] The "Size Quartiles" column in Table III divides the data into four quartiles based on the size of the bid within an issue. The investment banker favors large bids by awarding them a larger fraction of their bids than he awards small bidders. This result holds across all four quartiles, but most strikingly for the third and fourth (i.e., largest) quartiles.

shareholders do not have a better idea about the firm's cash flows, because of their participation in the local market, they may still have a better idea about domestic demand.

[12]The total number of shares allocated includes those backed by the overallotment option.

The "Bid Type" column in Table III divides bids according to whether they are strike, limit, or step bids. From the normalized rationing, we see that limit bids are favored relative to strike bids. Step bids are even more favored.

Another bid characteristic is whether they come from regular investors or from investors who participate only sporadically. We split the bidders into three categories. We define those who bid in ten or more issues as high-frequency bidders. Medium-frequency bidders are those who participate in three to nine issues. Bidders who participate in only one or two issues are defined as low frequency.[13] When we assign bidders to groups, we include missed limit bids but not cancelled bids. Missed limit prices are certainly relevant, because they provide information to the banker. Although cancelled bids indicate frequent contact between the investor and the banker, ultimately they do not represent bids for shares.

In the "Bid Frequency" column of Table III, we see that the underwriter favors high-frequency bidders relative to medium-frequency bidders who are in turn favored relative to low-frequency bidders.

A. Regression Analysis of Normalized Rationing on Bid Characteristics

The dependent variable in the regressions is normalized rationing (i.e., the ratio between allocation and bid, adjusted for oversubscription).[14] The independent variables capture different characteristics of the bid.

The first obvious characteristic is the size of the bid. Previous studies assume that large bidders are informed bidders. However, the size of the bid can also reflect exogenous conditions (such as how large the institution is). Further, treating large orders better is compatible with many alternative explanations, such as lower transaction costs. Therefore, we do not necessarily interpret size as a proxy for information. Instead, if the issuing company is worried about control or liquidity problems, then small bids should be favored.

We define two dummy variables to capture the bid's size: one variable takes a value of one if the bid is in the fourth (i.e., largest) quartile, and the second takes a

[13]We define a bidder's frequency based on all issues in which he participates. Thus, a bidder may be classified as frequent in an early issue on the basis of his participation in later issues.

[14]We use normalized rationing to control for the bias and heteroskedasticity that would arise if we used allocations or raw rationing.

value of one if the bid is in the third quartile.

In Section II we argued that limit and step bids convey more information than strike bids, and should receive more favorable treatment if the purpose of bookbuilding is to extract information. We create dummies for limit and step bids. Since there are few step bids, we also aggregate limit and step bids together and refer to these bids as *price bids*. Among strike bids we define a dummy for currency bids. Since the number of shares requested by a currency bid changes with the issue price, such bids fall partway between a strike and a limit bid.

We include a dummy that takes a value of one if the bid is revised while the book is open. The effect of this variable can go either way. On the one hand, if the investment bank wants to reward a bid that is submitted early, it will penalize a revised bid. On the other hand, if the information about the value of the stock changes over the bookbuilding period, a bid revision might provide additional information over time. Therefore, it should receive more favorable treatment.

We also include a dummy that takes a value of one if the bidder's nationality is the same as the nationality of the issuing company. This variable might capture an information effect, and should have a positive coefficient if we expect that domestic institutions have better information. On the other hand, the coefficient of this variable could be negative if the issuer is trying to build an international body of shareholders. However, it could still be positive if he prefers to favor domestic investors to avoid flowback.

In Section I we noted that in privatizations, domestic demand is allocated separately. Nonetheless, some domestic institutions are still occasionally present in the book as international investors. However, there are only a few of them and they may not be representative of domestic investors. As a result, the dummy for the bidder nationality primarily applies to nonprivatizations and we set the dummy to one only for nonprivatizations.

Another important characteristic is whether the bid comes from a regular investor. We create two dummies to capture regular investors, one for high-frequency bidders and one for medium-frequency, as defined earlier. We also include a dummy for early bidders, which takes a value of one if the bid is one of the first 25% submitted (based

on the date of the final revision).

Finally, we include a dummy that is set to one if the manager accepting the bid is the bookrunner (or one of its foreign subsidiaries). If the investment bank is interested in increasing its own fees, it will favor these bids.

To capture fixed effects, we also introduce a dummy for each issue, since each issue could have unique characteristics not captured by the variables in the regressions. We present the results in Table IV.

The size of the bid (especially bids in the largest quartile) has a positive and significant coefficient. All else equal, the investment banker allocates 27% more shares (as a percentage of the bid quantity) to bids in the largest-size quartile and 7% to bids in the second-largest-size quartile. In contrast to Brennan and Franks (1997), we find that obtaining a dispersed ownership and building a diverse holding base does not seem to be a concern for these international equity issues.

Limit and step bids receive an extra 19% and 26%, respectively. This finding is consistent with the information theories described above. The investment banker appears to favor informative bids with a larger share allocation. Currency bids are also favored, but only by 5%.

The coefficient of the dummy for revised bid is also positive and significant. This finding suggests that a revision provides more information to the investment banker. Similarly, the coefficient of the dummy for the nationality of the bidder is positive and significant, suggesting that the banker favors local investors. This result seems to support the hypothesis that local investors are better informed. However, the result could also be due to other preferences, for example, to avoid flowback.

Frequent bidders also receive substantially larger allocations, 23% more shares for the very-frequent and 12% more shares for medium-frequency bidders. This finding supports the Benveniste and Spindt (1989) hypothesis that frequent bidders are rewarded for providing insurance to the investment banker. Another explanation is that frequent investors have close relationships with the banker and are being favored for this reason.[15]

[15]One might question if limit bids and frequent investors might be awarded a larger fraction of their bid simply because they exaggerate their demand less. Although we cannot perfectly control

Surprisingly, the coefficient of the dummy for early bids is negative and statistically significant. This result suggests that early bidders receive worse treatment.

Finally, the coefficient of the dummy for the bookrunner as manager is not only positive and significant, but also the largest. This is the variable with the strongest effect on allocations, suggesting that the investment bank favors those who submit bids through its own salespeople. This result should be expected, since the bookrunner retains a larger portion of the investment banking fees if its own clients purchase the shares.

We can interpret the economic significance of the additional allocations estimated by the regressions in the context of the average allocation. The average allocation to each bidder is 0.63% of an entire issue, or about $1.4 million worth of stock. Each extra percent of allocation corresponds to an additional allocation of $14,000. For example, limit bids attract an extra 19% allocation (based on Regression 1), which corresponds to an additional $266,000 in stock.

In Regression 2, we aggregate step and limit bids as price bids and obtain very similar results. From now on, we use Regression 2 as the basic regression.

We repeat Regression 2, using Fama-MacBeth (1973) estimates and t-statistics, i.e., running a separate regression for each issue and averaging the coefficients. The results are substantially the same as in the basic regression. The most important difference is that the dummy for early bids becomes statistically insignificant and the coefficient of the bidder nationality is substantially higher.

In Regression 3 we introduce the effect of investors' industry on normalized rationing. This lets us look at whether the issuer or investment bank prefers investors from certain industries and also tests if the previous results remain when we control for the investors' industry.

The industries we consider are asset management, insurance, pension funds, banks, and private banking. Asset management comprises mutual funds, hedge funds, portfolio management, and investment management. Because our data set includes many

for the endogeneity, several statistics indicate that this is probably not the case. First of all, Table III clearly shows that limit bids and frequent investors submit larger bids on average. Moreover, large bids are the most favored, even among limit bids and bids from frequent investors.

bidders from every part of the world, we could not find enough information to classify all of them. However, we perform the analysis for those investors whose businesses we could identify. We find that 43.4% of the bids come from investors classified as investment managers, 4.3% from insurance companies, 2% from pension funds, 12.6% from banks, and 1.4% from private banking; 36.3% were unclassified.

In Regression 3, we can see that the effects of bid characteristics on rationing do not change. However, there are interesting differences among bidders from different industries. The investment banker favors investors in asset management, insurance, and pension funds. We also find that the coefficients for insurance companies and pension funds are much higher than the coefficient for asset management. This suggests that the investment bank favors the two types of investors who are typically seen as long-term investors.

B. Different Classes of Investors

We find that certain bid characteristics affect allocations. However, the investment banker could favor customers with whom he has a close relationship. These might be customers who are larger and more comfortable placing complex requests, such as limit and step bids. Therefore, we test whether the favorable treatment is the result of the bid characteristics, or if these characteristics are proxies for investors who are favored only by virtue of being "friends" of the investment banker.

We identify these investors in two ways. First, we identify bidders who often bid for large quantities, and those who often use limit or step bids. Second, we look at the allocations across all issues and directly identify the investors who are usually favored by the investment banker.

We define an investor's class only for those who bid on at least six issues (otherwise we cannot identify any pattern of behavior). Starting from the first criterion, we classify an investor as "large" if the frequency with which he submits large bids is in the top 25% of all investors who participated in at least six issues.[16] We classify an investor as "sophisticated" if he frequently submits price-contingent bids, and if his frequency of price bids is among the top half of bidders who submitted at least one

[16]The results have been reproduced by classifying investors according to their average (and median) bid percentage. The results are qualitatively the same.

price bid.

Finally, we classify investors by looking directly at whether they are usually favored in the allocation of shares. In each issue, we identify the 25% most favored bids. Then, for each issue we classify as "favored" investors the top quartile of bidders, ranked by the frequency with which their bids were favored in other issues.

We then look at whether the previously identified effects persist. In Table V, Panel A, we ask if it is still important that the bid percentage is in the top quartile. In Regression 1, we add to the basic regression a dummy that takes a value of one if the bid quantity is in the top quartile of all bids in the issue and is submitted by a "large" investor. In Regressions 2 and 3 we add terms for large bids submitted by "sophisticated" investors and "favored" investors, respectively.

In all three regressions, the coefficient of the dummy for bids in the largest quartile remains positive and significant, indicating that bid size matters even for investors that are not in any of the three special classes. We also find that the coefficients on each of the cross terms is positive and significant, indicating that large bids are even more favored when they come from bidders of the three investor classes.

In Panel B of Table V we perform a similar analysis. After controlling for the investor class, we look at whether it is important that a bid is a price bid. We find that submitting a price bid increases the allocation of shares regardless of the type of investor who is submitting the bid. Being a large or sophisticated investor does not increase the allocation for price bids. Only favored investors receive larger allocations than any other investor who submits a price bid.

We also control for bidder type in two other ways. In Regression 7, we add to the basic regression three dummies that capture the "large," "sophisticated," and "favored" investors. Finally, in Regression 8, we add individual dummies for every investor who took part in at least six issues. In both cases we find that the variables for bid size and price bid remain significant.[17]

Table V shows that the effects we find—i.e., that the investment bank favors bids with certain characteristics with larger allocations—do not happen just because the

[17]We compute Fama-MacBeth (1973) estimates for Regressions 1 through 7. The results are essentially the same.

underwriter favors a specific group or groups of investors.

C. Allocations and Oversubscription

Until now, we have looked at all issues as if they were substantially similar, independent of the level of oversubscription. However, the level of oversubscription might dictate different behavior by the investment banker. There are several reasons why this could happen. First of all, when the oversubscription is low, the investment banker does not have as much discretion in allocating shares. In the extreme case, if demand was exactly equal to supply, each bidder would receive exactly 100% of the shares requested. Therefore, we would expect smaller differences in the treatment of bids when oversubscription is low, regardless of the investment banker's objectives.

Second, when allocating shares, the investment banker could have expectations about aftermarket returns, based on the observed oversubscription. (In our sample, the correlation between oversubscription and aftermarket return is 0.45.) Thus, the banker could favor different investors on the basis of these expectations. Until now, when we have found that certain bids or bidders receive more shares than others, we have interpreted it as favorable treatment. Although investors who receive larger allocations can usually be considered favored, obtaining more shares is not necessarily an advantage. An investor might often receive large allocations, but will face adverse selection if the investment banker gives him larger allocations of the worse issues.

In Table VI we divide the issues into high and low oversubscription, based on whether the oversubscription is above or below the median (of three), and look at whether the investment banker follows different criteria when the oversubscription is high or low. We also report the Fama-MacBeth (1973) coefficients. The allocation rule appears to change between low and high oversubscription, mainly for bidders of high and medium frequency, and for bidders who submit their bids directly to the bookrunner. We find that these investors are strongly favored when the issue is very oversubscribed but less favored when the issue has a low oversubscription. The difference in the size of the coefficients is not only statistically significant but also quite large.

This finding supports the arguments presented above. First, when the oversubscription is low, the investment bank cannot have too much control over the alloca-

tion. This explanation seems particularly appropriate in the case of bids submitted through a bookrunner. If the issue is heavily oversubscribed, the investment bank can easily use its discretion to increase its own revenues. But if oversubscription is low, the underwriter might have to place many shares with customers of other syndicate members.

Second, if the oversubscription is a positive signal about the offering's chance of success, the investment banker favors certain bidders by allocating them more shares when the issue is oversubscribed. This explanation is particularly interesting in the case of very frequent investors. One possible interpretation is that frequent bidders are the "friends" of the investment bank and the banker wants to give them the most profitable shares. Another interpretation is the one given by Benveniste and Spindt (1989): Frequent bidders provide insurance because they bid for shares in both good and bad issues. The bank compensates them by rationing their allocations less than others'. However, if this preferential treatment were the same across all issues, frequent clients would still suffer from adverse selection and earn low returns. To provide positive returns, the investment bank must discriminate even more in their favor when it knows that the issue is oversubscribed.

The coefficients for large bids and price bids are not significantly different for high and low oversubscription issues. This finding supports the hypothesis that regardless of the level of oversubscription, the investment banker must extract information to price the issue accurately. Further, price bids are not subject to the same degree of adverse selection as frequent bidders, since the limit price protects the bidder if the price is set too high.

These results hold when we compute Fama-MacBeth (1973) estimates. The difference in the treatment of domestic bidders is no longer significant, but the favorable treatment for these bidders is significant only when oversubscription is low. This could be due to the investment bank being particularly concerned about flowback when oversubscription is low, thus choosing to allocate the shares directly to domestic investors.

D. IPOs and SEOs

Our analysis so far has pooled IPOs and SEOs. We now consider whether there

is a substantial difference in the allocation criteria between IPOs and SEOs.

At first glance, it is not clear why bookbuilding was used for these seasoned offerings, since any information should already be summarized in the premarket price. However, the investment bank built a book, because it believed that either the existing stock was illiquid or the new equity being issued was large relative to the shares already trading. The practice of building a book for SEOs is consistent with Parsons and Raviv (1985), who assume that investors have different reservation prices. Bookbuilding can be used to extract the private information about the reservation price. Loderer, Sheehan, and Kadlec (1991) find that SEOs that are similar to IPOs have a larger discount, since the investment bank does not know the individual investors' demand schedules and must solicit manifestations of interest. In fact, the average discount relative to the premarket price for the SEOs in our sample is 3%, which is quite high.

In Table VII, we divide the issues between IPOs and SEOs for our regression. We also report Fama-MacBeth (1973) estimates. We find that the allocation criteria are similar for IPOs and SEOs.[18] The coefficient of price bids is larger for IPOs than for SEOs, but the two coefficients are not significantly different from each other. One could argue that because there is less uncertainty surrounding SEOs than there is around IPOs, there is less need to remunerate informed investors. However, investors' information is also more precise, so it is not clear which effect should prevail. We note that bids in the largest size-quartile receive more favorable treatment in SEOs than IPOs, at the 1% confidence level. This supports the argument that the investment banker is concerned about the effect of the increased supply in the market, so that large bids are particularly useful.

E. Incentive Compatibility

One of the results that emerges from our analysis is that bids that contain information receive favorable treatment. This finding supports the theories that argue that bookbuilding is a mechanism designed to induce bidders to reveal their information. To check that this is indeed the case, we look at some detailed empirical

[18]We also conducted the same analysis, separating privatizations and non-privatizations. We found that the same bid characteristics largely affect the allocation of shares in privatizations as in other issues.

implications of these theories.

First, the marginal value of information should depend on the number of other informed bidders who reveal their information. If there are few price bids, an additional limit bid provides a lot of information to the bookrunner. If instead there are already numerous price bids, then one additional such bid provides little information.

In Regression 1 of Table VIII, we include a term that multiplies the dummy for price bid by a variable that captures the total number of price bids in the issue. (This variable is the demeaned logarithm of one plus the number of price bids in the issue.) If the investment banker compensates price bidders for the marginal value of their information, we should find a negative relation between this variable and the quantity of shares allocated. We do find a negative coefficient, but the result is not statistically significant. However, this lack of significance could be due to the smaller number of price bids relative to strike bids (and because of the lack of variation, since the variable for the number of price bids is common across all bids within each issue). We run Regression 2 only on price bids and the coefficient becomes significantly negative.

Second, the theory underlying the bookbuilding mechanism holds that it is incentive-compatible for an investor to reveal true information. Benveniste and Spindt (1989) and Biais and Faugeron-Crouzet (1999) show that a high signal should receive more favorable treatment than a low signal. This implies that a bid with a high limit price should be rationed less than a bid with a low limit price. It is certainly true that bids with low limit prices receive no shares if the issue price is higher than the limit price. But aside from that, do bids with higher limit prices receive larger allocations?

In Regression 3, we test whether the investment banker favors limit bids that have higher limit prices than competing limit bids in the same issue. For each limit bid we compute the percentage difference between its limit price and the quantity weighted average for all price bids in that issue, normalized by the percentage standard deviation of the limit prices in the issue.[19] In Regression 3, the coefficient on this variable is positive and significant, as predicted by theory.[20]

[19]We do not include step bids in the regression, since it is not clear which price to use.

[20]We also used as an explanatory variable the percentage by which the limit price exceeds the issue price. The results are similar.

We could argue that for very high limit bids the sign might reverse. If a limit price is too high to be credible, the bid should be equivalent to a strike bid. To impose incentive-compatibility on uninformed bidders, the investment banker might discourage such frivolous limit bids. However, there are only 26 limit bids in the entire data set that have limit prices more than two standard deviations away from the average limit price for each issue. In Regression 4, we define the difference between the limit price and the average limit price only for those limit bids that are less than two standard deviations from the average limit price. The effect becomes stronger.

We have argued that bid revisions could also be interpreted as providing information, and we have found that in allocating shares, the underwriter favors clients who revise their bids. In Regression 5, we divide revisions into three categories: revisions in which the final bid is a price bid, revisions in which the final bid is a strike bid but was previously a price bid, and revisions that were only strike bids. Our idea is that the first two types of revisions convey price information at some point, but not the last type of revision. We find that the coefficients for revisions that at some point included a limit price are positive and significant, but the coefficient for revisions that are always strike bids is not significantly different from zero. This result supports the hypothesis that revised bids receive more favorable treatment because they convey information. Fama-MacBeth (1973) estimates do not change the result.

This last finding raises the question of whether there is a difference between upward and downward revisions. To answer this question, we distinguish between strike and limit bids. We look at the initial bid and the final revision for each revised bid. For strike bids, we distinguish between revisions that increase the quantity and revisions that decrease the quantity. For limit bids, we consider both price and quantity revisions. We define a positive (negative) quantity revision of a limit bid as a revision in which the quantity is revised upward (downward) but the limit price is not changed. We also distinguish revisions in which the limit price was raised or lowered, regardless of any changes in the quantity requested. Regression 6 presents the results. We note that the only type of revision that is positive and significant is a price revision upwards. This is consistent with the idea that a high signal should receive more shares than a low signal. Revisions that only change the quantity of shares demanded, whether as strike bids or as limit bids, do not attract favorable

allocations.[21]

F. Profits

So far, we have focused on the allocation of shares. Whether share allocation is sufficient to determine which clients are favored depends on the assumption we make about the investment bank's information on aftermarket returns.

If the investment bank summarizes all its information in the issue price, underprices every issue by the same amount, and has no reason to believe that one issue is better than another, then it is sufficient to show (as above) that the investment banker favors some types of bids when he allocates shares, and we can conclude that he actually favors them in terms of profits. However, if we think that even after setting the issue price, the investment bank has reason to expect some issues will be more successful than others, then it is not enough to show that the investment bank favors some types of bids. We must also show that it favors them in the profitable issues. For example, Table VI shows that the investment bank favors frequent bidders when an issue is oversubscribed, which could be an indication that the bank expects higher profits. But what if the investment bank has different expectations about returns in different issues, and these expectations are not fully captured by oversubscription? Then the only way to see if the investment bank favors certain bidders is through the bidders' ex-post profits.

Although the banker has perfect control on the number of shares allocated, he has much less control over the final profits of the investors. Therefore, although in the previous sections we could clearly identify some of the investment banker's decision criteria, measuring profits is necessarily noisier.

In the context of bookbuilding (as opposed to fixed price offerings), profit is not a measure of an investor's ability to choose underpriced issues. The fact that some investors are informed does not mean that they are able to choose the winning issues. In the bookbuilding procedure, investors submit their demand before the issue price is set. Further, informed individuals reveal their information, which is impounded in the price, and these investors may no longer have an advantage in picking issues.

[21] "Other revisions" also receive larger allocations. These are revised bids which at some point were price bids but do not fall into the categories above.

Profits are instead driven by the investment banker's rationing decision.

Therefore, we investigate which types of investors are favored by looking at those who earn higher profits, given their bids. The variable we consider is the ratio between profit realized and the bid amount (in dollar terms). This ratio can be interpreted as returns to a bidding strategy. In other words, given the issues in which one bidder bids, and given the number of shares demanded, the investment banker can allocate shares to the benefit or detriment of that investor.[22]

In Table IX we regress this variable on the various bid characteristics. We do not introduce fixed effects, since we are looking at the investment bank's decision to allocate shares in high-return issues rather than low-return issues. Therefore, the differences across issues are a crucial element of the analysis and should not be eliminated by using fixed effects. We find that the coefficient for price bids is positive and significant. This result supports the hypothesis that the larger allocation given to price bids gets translated into favoritism in terms of profits. Bidders submitting price bids earn an extra 0.72% (as a percentage of the bid amount).

After controlling for the informativeness of an investor's bid, we find that the profits that accrue to frequent investors are not higher than those captured by others. This result supports the idea that these investors obtain shares not just because they are "friends" of the investment bank, but because they provide insurance by taking their share of the poor issues. The fact that the investment bank favors them with larger allocations (particularly in oversubscribed issues) is necessary to compensate them for the adverse selection they face, and does not give them high returns.

Other characteristics of the bids do not increase profits.

IV. Conclusion

Using a unique data set, we analyze the bids and allocations of equity issues which use the bookbuilding mechanism. We find a number of regularities in the way the investment banker rations shares to investors.

[22]Note that the actual return to a bidder, as a percentage of the amount invested, is the same for all bidders in an issue (and equivalent to the underpricing) and thus not very meaningful. Actual return, in this context, is only meaningful when multiplied by the number of shares allocated and normalized by the bid size. This is exactly the variable considered here.

First, the investment banker favors price-contingent bids. Our interpretation is that these bids provide information, which can be used by the investment bank to set the issue price.

Regular customers are also favored with larger allocations, but their profits do not seem to be higher than other investors'. This finding supports the hypothesis that such clients are compensated for buying shares both in good and bad issues.

In addition, the investment bank favors large bids, which indicates an apparent lack of concern with liquidity and control issues. Bidders from the issuer's country receive a favorable allocation. Since local investors can be viewed as better informed, this favorable treatment could be remuneration for revealing information. Revised bids are treated favorably, especially those that revise the limit price upwards. This result supports the hypothesis that revisions provide additional information over time. The investment banker also favors insurance companies and pension funds. Finally, favorable allocations are also given to clients who submit their bids directly to the bookrunner. This is probably because the investment bank is attempting to increase its own revenues by increasing its share of the selling fees.

References

Beatty, Randolph P. and Jay R. Ritter, 1986, Investment Banking, Reputation, and the Underpricing of Initial Public Offering, *Journal of Financial Economics* 15, 213-232.

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 Walid Y. Busaba, 1997, Bookbuilding vs. Fixed Price: An Analysis of Competing Strategies for Marketing IPOs, *Journal of Financial and Quantitative Analysis* 32, 383-403.

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.

Benveniste, Lawrence M. and William J. Wilhelm, 1997, Initial Public Offerings: Going by the Book, *Journal of Applied Corporate Finance* 10, 98-108.

Biais, Bruno and Anne Marie Faugeron-Crouzet, 1999, IPO Auctions, working paper, Université de Toulouse, France.

Brennan, Michael and Julian Franks, 1997, Underpricing, Ownership and Control in Initial Public Offerings of Equity Securities in the UK, *Journal of Financial Economics* 45, 391-413.

Cornelli, Francesca and David Goldreich, 2000, Bookbuilding: How Informative is the Order Book?, working paper, London Business School.

Chaplinsky, Susan and Latha Ramchand, 2000, The Impact of Global Equity Offerings, *The Journal of Finance* 55, 2767-2789.

Fama, Eugene F. and James D. MacBeth, 1973, Risk, Return and Equilibrium: Empirical Tests, *Journal of Political Economy* 81, 607-636.

Hanley, Kathleen and Willialm J. Wilhelm, 1995, Evidence on the Strategic Allocation of Initial Public Offerings, *Journal of Financial Economics* 34, 177-197.

Huang, Qi and Richard M. Levich, 1998, Underpricing of New Equity Offerings by Privatized Firms: An International Test, *mimeo*, New York University.

Ibbotson, Roger G., Jody L. Sindelar and Jay R. Ritter, 1994, The Market's Problems with the Pricing of Initial Public Offerings, *Journal of Applied Corporate Finance* 7, 66-74.

Jenkinson, Tim and Alexander Ljungqvist, 1996, *Going Public* (Oxford University Press), Oxford.

Jenkinson, Tim, Alexander Ljungqvist and William J. Wilhelm, 2000, Has the Introduction of Bookbuilding Increased the Efficiency of IPOs?, mimeo, Oxford University.

Kandel, Shmuel, Oded Sarig and Avi Wohl, 1999, The Demand for Stocks: An Analysis of IPO Auctions, *The Review of Financial Studies* 12, 227-247.

Karolyi, Andrew, 1999, Daimler-Chrysler AG, The First Truly Global Share, working paper, Ohio State University.

Keloharju, Matti, 1998, The Distribution of Information among Institutional and Retail Investors in IPOs, working paper, UCLA.

Lee, Philip J., Stephen L. Taylor and Terry S. Walter, 1999, IPO Underpricing Explanations: Implications from Investor Application and Allocation Schedules, *Journal of Financial and Quantitative Analysis* 34, no. 4.

Loderer, Claudio, Dennis R. Sheehan and Gregory B. Kadlec, 1991, The pricing of Equity Offerings, *Journal of Financial Economics* 29, 35-57.

Loughran, Tim, Jay R. Ritter and Kristian Rydqvist, 1994, Initial Public Offerings: International Insights, *Pacific-Basin Finance Journal* 2, 165-199.

Maksimovic, Vojislav and Pegaret Pichler, 1999, Private versus Public Offerings: Optimal Selling Mechanisms with Adverse Selection, working paper, University of Maryland.

Parsons, John and Artur Raviv, 1985, Underpricing of Seasoned Issues, *Journal of Financial Economics* 14, 377-397.

Ritter, Jay R., 1998, Initial Public Offerings, *Contemporary Finance Digest* 2, 5-30.

Rock, Kevin, 1986, Why New Issues are Underpriced, *Journal of Financial Economics* 17, pp. 187-212.

Sherman, Ann E., 1999, Global Trend in IPO Methods: Book Building vs. Auctions, working paper, University of Minnesota.

Sherman, Ann E. and Sheridan Titman, 1999, Buiding the IPO Order Book: Underpricing and Participation Limits With Costly Information, working paper, University of Texas, Austin.

Spatt, Chester and Sanjay Srivastava, 1991, Preplay Communication, Participation Restrictions, and Efficiency in Initial Public Offerings, *Review of Financial Studies* 4, 709-726.

Welch, Ivo, 1992, Sequential Sales, Learning, and Cascades, *Journal of Finance* 47, 695-732.

White, Halbert S., 1980, A Heteroskesaticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity, *Econometrica* 48, 817-838.

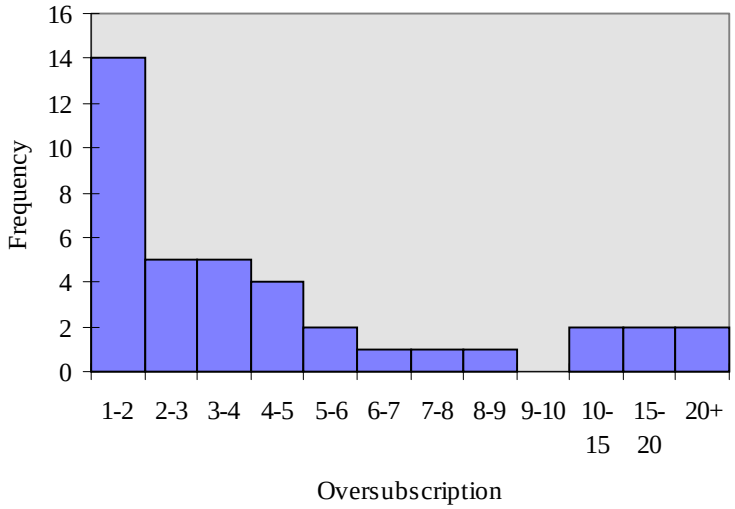

Figure 1. Oversubscription. This histogram displays the oversubscription, computed at the issue price, of the 39 equity issues in the sample. We define oversubscription as the sum of all bids (in shares) divided by the sum of shares allocated. The average and median oversubscriptions are 5.2 and 3.0, respectively. The maximum oversubscription is 22.

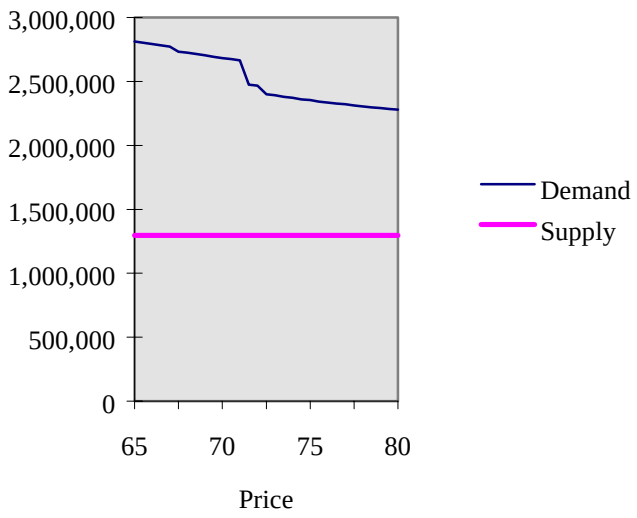

Figure 2. Example of demand and supply curves. This figure shows the demand and supply curves (in shares) for a single issue. Stated demand is much larger than the supply over the entire price range.

Table I
Issuer Summary Statistics

The table reports summary statistics for the 39 companies in our sample. We obtain the information from the prospectuses of the issuing companies. For each item we report both the mean and the median across all firms. We report means for IPOs, SEOs, privatizations, and nonprivatizations separately. The accounting figures have been converted to U.S. dollars and refer to the year prior to the equity issue. For age we report medians of the subsamples due to skewness. (Age excludes seven issues due to lack of information.)

	Mean	Median	IPOs	SEOs	Privatizations	Non Privatizations
Sales ($ million)	2,382	1,146	2,737	1,872	2,055	2,566
Earnings ($ million)	184	55	199	163	177	188
Assets (book value) ($ million)	7,660	1,414	6,487	9,346	8,257	7,326
Equity (book value) ($ million)	1,262	415	1,262	1,263	1,324	1,228
Age (years)	36	7	11.5[a]	7[a]	7[a]	7[a]
Offer price ($)	37.1	8.6	23.6	56.6	35.3	38.2
Total offer ($ million)	446	232	568	271	813	241
Primary offer ($ million)	110	51	154	46	72	131

[a] Median age

Table II
Example of the "Book"

This table is an excerpt from an actual book. It shows the bid details, including the quantity requested (which can either be denominated in currency units or in shares) and any revisions. The book includes any limit prices imposed by the bidder. This table also shows the actual number of shares allocated to each of these bidders as well as the allocation as a percentage of the number of shares requested. The issue price was 71.

Issue number	Bidder number	Manager	Bidder name	Country	Bid quantity		Bid type	Limit price	Allocation	Allocation/bid
5	1	3	aaa	Britain	1,000,000	GBP	Strike		0	0%
5	2	3	bbb	Austria	2,000,000	USD	Strike		24,800	61%
5	3	3	ccc	Britain	2,100,000	DEM	Strike		12,000	41%
5	4	3	ddd	Sweden	1,000,000	DEM	Strike			
	(revision 1)				600,000	DEM	Strike			
	(revision 2)				100,000	DEM	Strike		6,000	43%
5	5	4	eee	Germany	10,000	Shares	Step	69		
					5,000			75	3,000	60%
5	6	4	fff	Germany	250,000	DEM	Strike		2,100	60%
5	7	4	ggg	Germany	20,000	Shares	Limit	72	12,200	61%
5	35	4	hhh	Britain	20,000	Shares	Strike		8,400	42%
5	94	3	iii	Britain	20,000	Shares	Strike		5,000	25%
5	97	3	jjj	Switzerland	20,000	Shares	Strike		8,000	40%
5	101	3	kkk	Italy	20,000	Shares	Strike		8,000	40%

Table III
Rationing by Bid Criteria

For each subset of data, this table reports the average number of bids per issue, the average bid size as a percentage of the total demand in the issue, the average allocation as a percentage of the total supply allocated, the average rationing measured as the ratio of allocation to bid, and the average normalized rationing, which we define as the ratio of percentage allocation to percentage bid. We split the bids in each issue into quartiles based on bid size. Quartile 1 comprises the smallest bids and quartile 4 the largest. The average number of observations differs across size quartiles due to ties. Bid type splits the bids into categories depending on whether or not the bid includes a limit price (or multiple limit prices in the case of step bids). We define bid frequency as high, medium or low depending on whether the bidder participated in ten or more issues, three through nine issues, or less than three issues in the sample.

	Size quartiles				**Bid type**			**Bid frequency**		
	Smallest	2	3	Largest	Strike	Limit	Step	High	Medium	Low
N (per issue)	64.4	72.9	73.5	73.3	236.1	38.9	9.1	53.9	93.4	136.8
Percentage bid	0.04%	0.14%	0 .36%	1.88%	0.50%	1.00%	1.34%	0.83%	0.73%	0.46%
Percentage allocation	0.03%	0.10%	0.29%	2.02%	0.47%	1.09%	1.46%	0.95%	0.75%	0.38%
Rationing	23.1%	23.9%	28.3%	37.7%	22.3%	48.2%	54.2%	33.9%	30.0%	24.7%
Normalized rationing	58.0%	58.8%	70.2%	97.4%	66.9%	85.8%	96.4%	92.7%	77.9%	57.0%

Table IV
Effect of Bid Characteristics on Normalized Rationing

This table reports regression coefficients (and *t*-statistics in parentheses) for various model specifications. We adjust the *t*-statistics for heteroskedasticity using White's (1980) variance-covariance matrix. The dependent variable in all cases is the normalized rationing, which we define as the ratio of percentage allocation to percentage bid. The regressions include fixed effects dummies for each issue and give equal weight to each issue. The size dummies take a value of one if the bid is in the largest (or second largest) quartile for each issue. Limit and step dummies take a value of one if the bid is either a limit bid or a step bid. Price bids include both limit and step bids. Currency strike bid is set to one for strike bids whose quantity is denominated in currency units rather than shares. The early dummy takes a value of one if the bid is among the first 25% of all bids submitted in an issue. The revision dummy takes a value of one if the bid is revised at any time. The high (medium) frequency dummy takes value of one if the bid is submitted by a bidder that participates in more than ten (between three and nine) issues. The nationality dummy captures bidders from the same country as the issuer for issues that are not privatizations. Bookrunner as manager means the bid was submitted directly to the bank that acted as bookrunner. Regression 3 includes terms that indicate the bidder's industry when it could be identified. Regressions 2 and 3 are repeated with Fama-Macbeth (1973) estimates (FM) that average the coefficients of issue-by-issue regressions.

	Reg 1	**Reg 2**	**Reg 2 (FM)**		**Reg 3**	**Reg 3 (FM)**
Intercept	*	*	0.34 (7.0)		*	0.31 (6.1)
Largest size quartile	0.27 (13.2)	0.27 (13.3)	0.22 (4.7)		0.24 (11.5)	0.20 (4.2)
Second largest size quartile	0.07 (3.5)	0.07 (3.6)	0.06 (2.1)		0.05 (2.8)	0.05 (1.7)
Limit bid	0.19 (7.5)					
Step bid	0.26 (6.0)					
Price bid		0.20 (7.9)	0.24 (4.6)		0.19 (7.4)	0.22 (4.2)
Currency strike bid	0.05 (2.3)	0.05 (2.3)	0.08 (2.2)		0.04 (1.8)	0.07 (2.0)
Early bid	-0.05 (-2.5)	-0.05 (-2.5)	-0.01 (-0.4)		-0.05 (-2.6)	-0.01 (-0.4)
Revised bid	0.08 (3.5)	0.08 (3.6)	0.08 (2.2)		0.08 (3.9)	0.08 (2.3)
High frequency	0.23 (8.0)	0.23 (7.9)	0.19 (4.6)		0.20 (6.6)	0.17 (4.3)
Medium frequency	0.13 (6.8)	0.12 (6.7)	0.09 (3.2)		0.09 (4.7)	0.07 (2.6)
Bidder nationality	0.08 (2.6)	0.09 (2.7)	0.17 (2.4)		0.09 (3.0)	0.16 (2.5)
Bookrunner as manager	0.35 (17.0)	0.35 (17.0)	0.35 (4.1)		0.34 (16.5)	0.35 (4.0)
				Asset management	0.10 (4.8)	0.08 (3.6)
				Insurance company	0.25 (6.7)	0.29 (3.8)
				Pension fund	0.26 (5.5)	0.33 (3.2)
				Bank	-0.02 (-0.6)	-0.01 (-0.5)
				Private banking	-0.06 (-0.8)	0.00 (0.1)
Adjusted R-squared	13.1%	13.1%			13.6%	
N	11077	11077			11077	

Table V
Effect of Investor Type on Normalized Rationing

This table reports regression coefficients, and White (1980) heteroskedasticity adjusted *t*-statistics in parentheses, for various model specifications. The dependent variable in all cases is the normalized rationing, which we define as the ratio of percentage allocation to percentage bid. Bid characteristics are as defined in Table IV. The regressions include fixed effects for each issue and give equal weight to each issue. We define investor types for bidders who participated in at least six issues. "Large investors" are those who are in the top quartile based on the percentage of their submitted bids that are large, where "large" bids are defined as bids within the top size quartile in an issue. "Sophisticated investors" are those who are in the top half of those investors who each submitted at least one price bid, based on the percentage of their bids which are price bids. "Favored investors" are those in the top quartile based on the percentage of their bids (in other issues) that were most favored in the rationing of shares. (A bid is considered "most favored" if the allocation of shares as a percentage of the bid is in the top quartile within an issue). Regressions 1 through 3 include terms for the interaction between bids in the top size quartile and investor type. Regressions 4 through 6 include terms for the interaction between price bid and investor type. Regression 7 includes dummies for each of the investor types and Regression 8 includes individual dummies for each investor who bid in at least six issues.

	Panel A: Bid size and investor type						**Panel B: Price bids and investor type**						**Panel C**		
	Reg 1		**Reg 2**		**Reg 3**		**Reg 4**		**Reg 5**		**Reg 6**			**Reg 7**	**Reg 8**
Largest size quartile	0.21 (9.9)		0.23 (10.8)		0.20 (9.6)		0.26 (13.1)		0.27 (13.3)		0.26 (13.0)			0.19 (8.7)	0.14 (6.3)
Second largest size quartile	0.07 (3.7)		0.07 (3.7)		0.07 (3.7)		0.07 (3.6)		0.07 (3.6)		0.07 (3.5)			0.05 (2.8)	0.04 (2.1)
Price bid	0.19 (7.5)		0.19 (7.6)		0.19 (7.5)		0.19 (7.4)		0.19 (7.3)		0.17 (6.9)			0.16 (6.3)	0.14 (5.3)
Currency strike bid	0.04 (1.9)		0.05 (2.2)		0.04 (2.1)		0.05 (2.4)		0.05 (2.3)		0.05 (2.4)			0.03 (1.5)	0.03 (1.5)
Early bid	-0.04 (-2.4)		-0.05 (-2.5)		-0.04 (-2.5)		-0.05 (-2.5)		-0.05 (-2.5)		-0.05 (-2.5)			-0.04 (-2.3)	-0.02 (-1.3)
High frequency	0.20 (6.6)		0.20 (6.5)		0.19 (6.3)		0.22 (7.6)		0.23 (7.4)		0.22 (7.2)			0.08 (2.5)	
Medium frequency	0.11 (5.9)		0.12 (6.2)		0.11 (6.0)		0.12 (6.6)		0.12 (6.5)		0.12 (6.4)			0.07 (3.9)	0.13 (5.7)
Revised bid	0.08 (3.6)		0.07 (3.5)		0.08 (3.8)		0.08 (3.6)		0.08 (3.6)		0.08 (3.7)			0.08 (3.8)	0.07 (3.2)
Bidder nationality	0.09 (2.8)		0.09 (2.7)		0.09 (2.8)		0.09 (2.7)		0.09 (2.7)		0.09 (2.7)			0.09 (3.0)	0.09 (3.4)
Bookrunner as manager	0.35 (16.9)		0.35 (17.0)		0.35 (16.9)		0.35 (17.0)		0.35 (17.0)		0.35 (17.0)			0.34 (16.8)	0.37 (19.3)
Largest size quartile X Large Investors	0.22 (6.4)	Largest size quartile X Sophisticated Investors	0.15 (4.2)	Largest size quartile X Favored Investors	0.29 (7.8)	Price bid X Large Investors	0.05 (1.1)	Price bid X Sophisticated Investors	0.01 (0.3)	Price bid X Favored Investors	0.13 (2.7)	Large investors		0.07 (1.8)	
												Sophisticated investors		0.07 (2.1)	
												Favored investors		0.36 (8.3)	
Adjusted R-squared	13.4%		13.2%		13.6%		13.1%		13.1%		13.2%			14.8%	17.2%
N	11077		11077		11077		11077		11077		11077			11077	11077

Table VI
Effect of Oversubscription on Normalized Rationing

These regressions distinguish between low and high oversubscription issues, where low oversubscription is defined as less than 3 (i.e. the median). White (1980) heteroskedasticity-adjusted *t*-statistics are in parentheses. The dependent variable in all cases is the normalized rationing, which we define as the ratio of percentage allocation to percentage bid. The regressions include fixed effects dummies for each issue and give equal weight to each issue. The size dummies take a value of one if the bid is in the largest (or second largest) quartile for each issue. The price bid dummy includes both limit and step bids. Currency strike bid is set to one for strike bids whose quantity is denominated in currency units rather than shares. The early dummy takes a value of one if the bid is among the first 25% of all bids submitted in an issue. The revision dummy takes a value of one if the bid is revised at any time. The high (medium) frequency dummy takes value of one if the bid is submitted by a bidder that participates in more than ten (between three and nine) issues. The nationality dummy captures bidders from the same country as the issuer for issues that are not privatizations. Bookrunner as manager means the bid was submitted directly to the bank that acted as bookrunner. We repeat the regressions using Fama-MacBeth (1973) estimates (FM).

	Reg 1		**Reg 2**	**Reg1 (FM)**		**Reg 2 (FM)**
	Low oversubscription		**High oversubscription**	**Low oversubscription**		**High oversubscription**
Intercept				0.44	*	0.25
				(7.9)		(3.5)
Largest size quartile	0.28		0.27	0.25		0.20
	(15.9)		(8.8)	(5.5)		(2.4)
Second largest size quartile	0.12		0.05	0.10		0.02
	(6.7)		(1.7)	(3.5)		(0.4)
Price bid	0.20		0.22	0.22		0.25
	(9.7)		(4.7)	(5.0)		(2.8)
Currency strike bid	0.02		0.04	0.03		0.13
	(0.8)		(1.2)	(1.0)		(2.0)
Early bid	0.04	**	-0.10	0.03		-0.05
	(2.7)		(-3.3)	(1.1)		(-1.3)
Revised bid	0.07		0.05	0.04		0.11
	(3.8)		(1.4)	(1.7)		(1.7)
High frequency	0.05	**	0.38	0.04	**	0.33
	(2.6)		(10.3)	(1.1)		(6.0)
Medium frequency	0.00	**	0.23	0.00	**	0.18
	(0.0)		(7.3)	(0.1)		(4.1)
Bidder nationality	0.22	**	-0.13	0.26		0.00
	(10.2)		(-3.0)	(4.3)		(0.0)
Bookrunner as manager	0.13	**	0.55	0.15	*	0.55
	(17.9)		(18.8)	(3.8)		(3.5)
Adjusted R-squared	13.2%		12.7%			
N	3303		7774			

* Coefficients for high and low oversubscription significantly different from each other at the 5% level
** Coefficients for high and low oversubscription significantly different from each other at the 1% level

Table VII
Effect of Bid Characteristics on Normalized Rationing for IPOs and SEOs

These regressions distinguish between IPOs and SEOs. White (1980) heteroskedasticity-adjusted *t*-statistics are in parentheses. The dependent variable in all cases is the normalized rationing, which we define as the ratio of percentage allocation to percentage bid. The regressions include fixed effects dummies for each issue and give equal weight to each issue. The size dummies take a value of one if the bid is in the largest (or second largest) quartile for each issue. The price bid dummy includes both limit and step bids. Currency strike bid is set to one for strike bids whose quantity is denominated in currency units rather than shares. The early dummy takes a value of one if the bid is among the first 25% of all bids submitted in an issue. The revision dummy takes a value of one if the bid is revised at any time. The high (medium) frequency dummy takes value of one if the bid is submitted by a bidder that participates in more than ten (between three and nine) issues. The nationality dummy captures bidders from the same country as the issuer for issues that are not privatizations. Bookrunner as manager means the bid was submitted directly to the bank that acted as bookrunner. We repeat the regressions using Fama-MacBeth (1973) estimates (FM).

	Reg 1		**Reg 2**	**Reg1 (FM)**		**Reg 2 (FM)**
	IPO		**SEO**	**IPO**		**SEO**
Intercept				0.44	**	-0.02
				(6.7)		(-0.3)
Largest size quartile	0.19	**	0.39	0.14	*	0.34
	(6.9)		(13.1)	(2.3)		(5.0)
Second largest size quartile	0.04	*	0.12	0.03		0.11
	(1.3)		(5.0)	(0.8)		(2.4)
Price bid	0.22		0.17	0.27		0.19
	(6.1)		(5.1)	(3.6)		(2.9)
Currency strike bid	0.13	**	-0.07	0.16	*	-0.01
	(4.5)		(-2.6)	(3.0)		(-0.3)
Early bid	-0.07		0.00	-0.02		0.00
	(-2.9)		(-0.1)	(-0.4)		(0.1)
Revised bid	0.04	*	0.14	0.05		0.12
	(1.2)		(4.5)	(1.1)		(1.9)
High frequency	0.24		0.21	0.20		0.18
	(5.7)		(6.4)	(3.3)		(3.2)
Medium frequency	0.10		0.18	0.06		0.14
	(3.9)		(6.7)	(1.7)		(2.9)
Bidder nationality	0.05	**	0.26	0.16		0.19
	(1.3)		(5.8)	(1.8)		(1.7)
Bookrunner as manager	0.34		0.37	0.28		0.46
	(12.3)		(12.7)	(2.7)		(3.0)
Adjusted R-squared	8.7%		28.9%			
N	7336		3739			

* Coefficients for high and low oversubscription significantly different from each other at the 5% level
** Coefficients for high and low oversubscription significantly different from each other at the 1% level

Table VIII
Effect of Marginal Information and Revisions on Normalized Rationing

The dependent variable in all regressions is the normalized rationing, which we define as the ratio of percentage allocation to percentage bid. White (1980) heteroskedasticity-adjusted *t*-statistics are in parentheses. All regressions contain issues fixed effects dummies and give equal weight to each issue. The size dummies take a value of one if the bid is in the largest (or second largest) quartile for each issue. The price bid dummy includes both limit and step bids. Currency strike bid is set to one for strike bids whose quantity is denominated in currency units rather than shares. The early dummy takes a value of one if the bid is among the first 25% of all bids submitted in an issue. The revision dummy takes a value of one if the bid is revised at any time. The high (medium) frequency dummy takes value of one if the bid is submitted by a bidder that participates in more than ten (between three and nine) issues. The nationality dummy captures bidders from the same country as the issuer for issues that are not privatizations. Bookrunner as manager means the bid was submitted directly to the bank that acted as bookrunner. Regression 1 includes a dummy for price bid multiplied by the (demeaned) logarithm of the total number of price bids in the issue plus one. Regression 2 repeats Regression 1 but is run only over price bids. Regression 3 is run only over limit bids and includes a term that is the percentage difference between each limit price and the quantity-weighted average limit price in the issue, normalized by the standard deviation. Regression 4 repeats Regression 3 but excludes bids with limit prices that are more than two standard deviations away from the average limit price. Regression 5 splits revisions into three categories based on the type of the original bid and the revised bid. Regressions 6 separates upward and downward revisions (both in terms of price and quantity). Quantity increases and decreases are limited to those for which limit price, if any, is unchanged. We repeat Regressions 5 and 6 using Fama-Macbeth (1973) estimates (FM).

	Reg 1	**Reg 2**	**Reg 3**	**Reg 4**		**Reg 5**	**(FM)**		**Reg 6**	**(FM)**
Intercept	*	0.48	*	0.47		*	0.34		*	0.34
		(16.5)		(17.1)			(7.0)			(6.9)
Largest size quartile	0.27	0.28	0.31	0.29		0.27	0.22		0.27	0.22
	(13.3)	(7.7)	(9.3)	(7.4)		(13.2)	(4.6)		(13.6)	(4.6)
Second largest size quartile	0.07	0.10	0.13	0.12		0.07	0.06		0.07	0.06
	(3.6)	(2.8)	(4.2)	(3.3)		(3.4)	(2.1)		(3.7)	(2.1)
Price bid	0.17					0.16	0.18		0.16	0.21
	(6.3)					(6.0)	(3.0)		(6.2)	(3.7)
Currency strike bid	0.05					0.05	0.07		0.05	0.07
	(2.4)					(2.6)	(1.9)		(2.4)	(1.9)
Early bid	-0.05	0.04	0.08	-0.03		-0.04	-0.01		-0.04	-0.01
	(-2.5)	(1.1)	(2.2)	(-1.0)		(-2.4)	(-0.2)		(-2.4)	(-0.2)
Revised	0.08	0.18	0.19	0.16						
	(3.6)	(4.9)	(5.3)	(4.4)						
High frequency	0.23	0.22	0.16	0.22		0.24	0.20		0.24	0.20
	(7.9)	(5.1)	(3.8)	(4.7)		(8.1)	(4.8)		(8.2)	(4.8)
Medium frequency	0.12	0.14	0.10	0.15		0.13	0.09		0.13	0.09
	(6.7)	(4.3)	(3.0)	(4.0)		(6.9)	(3.3)		(6.8)	(3.2)
Bidder nationality	0.08	0.20	0.15	0.20		0.08	0.17		0.08	0.17
	(2.7)	(6.4)	(4.1)	(5.7)		(2.5)	(2.5)		(2.6)	(2.5)
Bookrunner as manager	0.35	0.22	0.16	0.23		0.35	0.36		0.35	0.36
	(17.0)	(7.1)	(4.5)	(6.6)		(17.0)	(4.0)		(17.0)	(4.1)
					Revisions:			Revisions:		
Log number of price bids	-0.06	-0.04			Final bid = price bid	0.16	0.21	Quantity increase (strike to strike)	-0.05	-0.02
	(-1.4)	(-2.7)				(4.6)	(2.5)		(-1.5)	(-0.8)
					From price bid to strike	0.32	0.27	Quantity decrease (strike to strike)	0.07	0.22
						(5.0)	(2.6)		(1.4)	(2.3)
Lim price - avg lim price avg lim Price			0.06	0.08	From strike to strike	-0.01	-0.01	Quantity increase (price bid)	0.02	0.03
			(3.3)	(4.3)		(-0.3)	(-0.3)		(0.3)	(0.3)
								Quantity decrease (price bid)	0.07	0.05
									(0.7)	(0.3)
								Limit price increase	0.28	0.18
									(5.3)	(2.2)
								Limit price decrease	-0.06	-0.01
									(-0.6)	(-0.1)
								Other revisions	0.27	0.24
									(5.4)	(2.6)
Adjusted R-squared	13.1%	16.7%	39.5%	20.5%		13.3%			13.4%	
N	11077	1871	1517	1491		11077			11077	

Table IX
Effect of Bid Characteristics on Profits

The dependent variable in this regression is the ratio between profit and bid amount (in dollars) for each bid (multiplied by 100). White (1980) heteroskedasticity-adjusted *t*-statistics are in parentheses. The regression gives equal weight to each issue. The size dummies take a value of one if the bid is in the largest (or second largest) quartile for each issue. The price bid dummy includes both limit and step bids. Currency strike bid is set to one for strike bids whose quantity is denominated in currency units rather than shares. The early dummy takes a value of one if the bid is among the first 25% of all bids submitted in an issue. The revision dummy takes a value of one if the bid is revised at any time. The high (medium) frequency dummy takes value of one if the bid is submitted by a bidder that participates in more than ten (between three and nine) issues. The nationality dummy captures bidders from the same country as the issuer for issues that are not privatizations. Bookrunner as manager means the bid was submitted directly to the bank that acted as bookrunner.

Intercept	0.21 (3.1)
Largest size quartile	0.16 (1.7)
Second largest size quartile	0.10 (1.3)
Price bid	0.72 (8.3)
Currency strike bid	-0.30 (-3.6)
Early bid	0.13 (1.6)
Revised bid	-0.17 (-1.5)
High frequency	0.13 (1.2)
Medium frequency	-0.03 (-0.3)
Bidder nationality	-0.32 (-3.0)
Bookrunner as manager	-0.09 (-1.1)
Adjusted R-squared	3.0%
N	11077