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A friend in need is a friend indeed: Allocation and demand in IPO bookbuilding

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ABSTRACT

This paper uses proprietary data on European IPOs with detailed information on the demand at different points of time and allocation for institutional and retail investors. The nature of the data allows us to analyze the reason of why institutional investors as a group get more allocations of underpriced issues than retail investors. By explicitly examining institutional and retail demand for different kinds of stocks, we find that this is due to institutional investors' superior ability to detect underpriced stocks rather than the underwriter's preferential treatment. At the same time, the subset of domestic institutional investors supports the underwriter in issues with weak demand and receives in turn favorable allocations in underpriced issues.

1. Introduction

Bookbuilding, the worldwide dominant procedure for selling IPOs, gives the underwriter a high degree of discretion in the pricing and allocation decision. High average levels of underpricing are observed, while there is anecdotal evidence for abusive allocation practices in a number of cases.[1] This raises the question which criteria guide the underwriter's decisions.

Previous research has documented favorable allocations for institutional investors in IPOs, but data limitations have widely constrained the ability to test the underlying reasons. This research, such as Aggarwal et al. (2002), has asked whether favorable allocations are due to differences in demand or allocation. Do institutional investors have a superior ability to detect underpriced issues or are

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[1] As an example, the SEC charged CSFB with abusive IPO allocation practices on January 22, 2002. These practices included in particular profit-sharing activities in which customers transferred parts of their flipping profits back to CSFB by excessively high brokerage commissions.

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they simply favored by the underwriter's allocation decision? This is an important question from a regulatory standpoint, as documented by several investigations by the SEC and others. And it is a crucial consideration for the agents in the issuing process such as issuers and investors.

This paper uses proprietary data on European IPOs brought to the market by a top-tier investment bank that is the market leader in Europe. Among the bookrunner and co-bookrunners are six of the top ten U.S. underwriters in 2001. While previous papers analyzed either the demand and allocation for institutional investors or the allocation for institutional and retail investors, this data set allows for the first time to analyze the full picture. It considers the dynamics of the demand by institutional *and* retail investors during the bookbuilding period as well as the final demand *and* allocation for retail *and* institutional investors. This enables us to analyze the reason for the preferential allocations to institutional investors as well as to observe the dynamics of the demand process.

The results suggest that institutional investors as a group receive better allocations than retail investors because of their superior ability to detect underpriced issues. They use their full decision space by adjusting both their demand elasticity and quantity, whereas retail investors concentrate on the quantity dimension. This is consistent with the notion that certain investors possess informational advantages with respect to the value of IPOs, which forms the basis of Rock (1986) and Benveniste and Spindt (1989). It cannot be shown that the underwriter favors institutional investors as a group in the allocation decision. Demand by institutional and retail investors is not treated differently on average.

The results differ though for the two sub-groups of institutional investors, which are domestic and foreign institutional investors. While the final demand share of foreign institutional investors is significantly higher in underpriced than in overpriced issues, the opposite tends to hold for domestic institutional investors. At the same time, the latter receive significantly better allocations. This raises the question whether domestic institutional investors are not as well informed as foreign institutional investors and why the underwriter rewards the seemingly less well informed investors.

The analysis of the dynamics of demand during the bookbuilding period provides evidence for a quid pro quo that is consistent with Benveniste and Spindt (1989). The results suggest that domestic institutional investors support the underwriter in "lemons," i.e. the issues with weak demand. They step in at the end of the bookbuilding period, 24 to 48 hours before the actual offer, submit (further) demand and guarantee the placement success for these issues. While they receive pro-rata allocations in these issues, they are compensated with more than pro-rata allocations in highly underpriced issues. These results suggest that domestic institutional investors are "a friend in need a friend indeed." The paper thus provides a direct test of the predictions by Benveniste and Spindt (1989) and finds consistent empirical evidence. The results suggest that the underwriter can use his leverage with informed investors to induce them to submit bids for eventually overpriced issues with weak demand by promising them better allocations in underpriced IPOs in the future.[2]

The fact that this quid pro quo guarantees issuers a high placement probability in IPO bookbuilding helps to answer the question why issuers may choose this mechanism despite substantial levels of underpricing. Issuers and their managers and owners may consider the placement success as crucial because of the substantial benefits from going public on the corporate and personal level.

The allocation of shares in IPOs is first illustrated in Hanley and Wilhelm (1995). They find that institutional investors receive similar allocations in overpriced and underpriced issues. Ljungqvist and Wilhelm (2002) find that institutional investors are favored in IPO allocations, but that the underwriter's discretion enables issuers to minimize the level of underpricing. Aggarwal et al. (2002) update and extend the allocation analysis of Hanley and Wilhelm (1995) by considering a more recent and larger sample of IPOs and underwriters. They find a positive relation between institutional allocation and underpricing, which they attribute both to the behavior of the bookbuilding bank and to institutional investors' private information. Boehmer and Fishe (2004) provide evidence that underwriters require regular investors to participate in weak IPOs for access to underpriced IPOs. In this paper we

[2] This leverage in a repeated game is referred to as "quid pro quo" in this paper. The expression is thus used in the same way as in Hanley and Wilhelm (1995), but in a different context than in e.g. Nimalendran et al. (2007) where "quid pro quo" primarily refers to immediate profit sharing activities, as for example described in footnote 1.

combine the analysis of the allocation outcome with that of the investors' demand. This allows us to directly test for the relative roles that the underwriter's discretion and the investors' demand play in the aggregate allocation outcome.

The demand for shares in IPOs is analyzed in a number of papers. Kandel et al. (1999) and Liaw et al. (2001) analyze investors' demand in IPO auctions. Amihud et al. (2003) analyze IPOs in Israel under a strict pro rata regime. They find a negative correlation between allocations to uninformed investors and underpricing, where uninformed investors earn a negative allocation-weighted initial return. Lee et al. (1999) show for IPOs in Singapore that inferences depend substantially on whether they are drawn from demand or allocation. In this paper we analyze which demand characteristics govern the underwriter's discretion in matching the supplied shares and the investors' demand.

The matching of allocation *and* demand is first analyzed by Cornelli and Goldreich (2001, 2003) for institutional investors. Jenkinson and Jones (2004) employ a similar sample of IPOs marketed by a different underwriter. Puri and Rocholl (2008) analyze the matching for different groups of retail investors. Here we analyze the matching of allocation *and* demand for institutional *and* retail investors. This simultaneous analysis is crucial, as both investor groups submit substantial demand shares. This allows us to directly test the reward for information by considering the difference in informativeness between institutional and retail investors and its impact on the underwriter's allocation decision. Furthermore, the analysis of the demand evolution over time sheds light on potential interactions between underwriter and investors. To our knowledge, this is the first paper that considers the demand dynamics during the bookbuilding period.[3]

The paper is organized as follows. Section 2 describes the original data set and the bookbuilding process. Section 3 derives testable empirical hypotheses from Benveniste and Spindt (1989). Section 4 analyzes the informativeness of investors' demand. Section 5 provides evidence for the underwriter's intervention under a quid pro quo arrangement. Section 6 focuses on the allocation decision and the matching of allocation and demand. Section 7 provides robustness tests. Section 8 concludes.

2. Description of data and bookbuilding process

The sample consists of aggregate order book data for 41 European IPOs between 1997 and 2001 that were issued by a top-tier investment bank that is the market leader in Europe.[4] These are all the IPOs that were brought to the market by this bank during this time. The sample bank is the global bookrunner for all the issues in the data set and its order book comprises all the bidding information at the end of the bookbuilding period. It is the sole global bookrunner for 25 issues, while global co-bookrunners are involved for 16 issues. Among the bookrunner and the co-bookrunners are six of the top ten U.S. underwriters in 2001.[5] The issuing companies come from six countries and represent a broad range of industrial sectors.[6] The sample covers a broad variety of large traditional as well as small growth companies, which were issued either at traditional or growth segments of European stock markets.

Demand and allocation data are available for two aggregate investor groups: institutional and retail investors.[7] Both groups represent a substantial share of both demanded and allocated shares. Data are

[3] Cornelli and Goldreich (2001) analyze whether the allocation to a specific institutional investor depends on when a bid is submitted and whether it is revised during the bookbuilding period. They show that investors who submit their bids early receive worse treatment and that investors who revise their bids receive better treatment. In this paper, we consider how much demand is submitted on each given day by each of the investor groups and how this relates to the aggregate demand and supply as well as the allocation of shares.

[4] 8 of these IPOs take place in 1997, 8 in 1998, 13 in 1999, 9 in 2000, and 3 in 2001. Among the 41 IPOs is one privatization. One sample IPO with an exceptionally large issuing volume is excluded from the value-weighted analyses.

[5] On average, the syndicate as a whole comprises more than five banks (median: 4), and bids are submitted on average by investors from 28 countries (median: 29).

[6] 35 of the sample IPOs are issued in the country in which the sample underwriter is headquartered; the remaining six IPOs are issued in the five other countries.

[7] The offerings for institutional and retail investors are not separate, and bookbuilding is not restricted to institutional investors. There is no restriction either on the demand by and the allocation to either of the two groups. Retail investors may submit the same type of bids as institutional investors by indicating quantities and limit prices.

Table 1a
Descriptive statistics: Issuer and issue characteristics for sample and U.S. IPOs.

	Sample mean	U.S. mean	Sample median	U.S. median	*t*-statistic
# of issuers	41	1616	41	1616	
Issuer characteristics					
Sales	€1003.8	$644.9	€65.0	$50.3	0.80
Earnings	€42.1	$13.5	€4.0	$0.4	0.94
Assets	€3014.3	$3,276.4	€76.6	$70.6	−0.01
Equity	€296.1	$252.4	€16.2	$27.4	0.24
Age (years)	28.4	9.3	14.0	6.8	4.21***
Issue characteristics					
Capital increase (%)	64.3	82.7	76.9	100.0	−3.70***
Free-float (%)	38.4	27.1	32.2	24.4	3.41***
Bookbuilding range (in %)	16.97	15.75	16.67	15.38	0.07
Subscription	24.57	NA	13.12	NA	NA
Update (in %)	3.23	2.47	6.38	0.00	0.13
Underpricing (in %)	32.7	41.6	5.77	16.61	1.12
Gross proceeds	€366.1	$123.2	€111.1	$61.0	4.89***

Notes. The figures for the sample issuers are taken from the issuing prospectuses. Accounting figures refer to the year prior to the IPO. Unless otherwise indicated, sample figures are in EUR million. For sample companies from non-EURO countries, figures are converted into EURO. For balance sheet figures, the closing exchange rate of the last trading day in the respective year is applied; for figures from the P&L statement, the average is taken of the closing exchange rates at the last trading day of all months within this year. The U.S. data are taken from the SDC Database and include 1616 common stock offerings between 1997 and 2001, excluding ADRs, unit offers, partnerships, closed-end funds, banks, S&ls, REITs, and IPOs with offer price below $5. Unless otherwise indicated, U.S. figures are in $ million. Capital increase is the percentage of the offer proceeds that come from a capital increase. Free-float is the share of the company that is publicly traded after the IPO (in %). Bookbuilding range is the ratio of the range size and its midpoint (in %). Subscription is the ratio of the number of shares demanded at the lower range end and shares supplied. Update is the change between the range midpoint and the offer price (in %). Underpricing is the change between the offer price and the closing price of the first trading day (in %).

*** Significance at the 1 percent level.

available as well for the two sub-groups of institutional investors: domestic and foreign institutional investors. An institutional investor is classified as domestic if its headquarters are located in the same country in which the IPO is listed and offered to retail investors.[8] This criterion provides a clear classification, as none of the sample IPOs is listed and offered to retail investors in more than one country. Foreign institutional investors are investors from all other countries.[9]

For each issue, the data comprise information on the evolution of the demand *during* the bookbuilding period as well as on the final demand and the allocation *at the end* of the bookbuilding period. During the bookbuilding period, the net number of share bids by domestic and foreign institutional and retail investors as aggregate groups is observed at the end of each day. At the end of the bookbuilding period, the total demand by each investor group at each price step within the bookbuilding range is observed.[10] The allocation figures indicate how many shares each sub-group receives at the respective offer price. Information on the issuing companies is extracted from their issuing prospectuses and first annual reports after the IPO.

Table 1a provides the descriptive statistics for the sample issuers and for all U.S. issuers between 1997 and 2001, for which data are taken from the SDC Database. The key characteristics of the sample issuers such as sales, earnings, assets, and equity are not statistically different from those of the U.S. issuers. The figures are consistent though with the observation that European issuers sell a higher

[8] A foreign subsidiary of a multinational institutional investor is classified as domestic if the subsidiary is a separate legal entity and submits the bids for the IPO. According to the bankers, this demand is very small in comparison to that of national headquarters of institutions.

[9] This means that different countries are subsumed by the classification, dependent on the respective IPO.

[10] Investors can submit bids in a discrete price grid; in most of the sample IPOs with steps of EUR 0.10 or EUR 0.25.

fraction of their company in the IPO and issue at a later stage of their life cycle than American companies.[11] Other important issue characteristics such as the size of the bookbuilding range, the price update before the IPO, and the level of underpricing are similar for the sample and the U.S. IPOs.

A specific institutional characteristic of European IPOs is the existence of a when-issued market. The prices of the transactions in this market are publicly available and provide a good prediction of prices in the aftermarket, as shown by Löffler et al. (2005) and Cornelli et al. (2006). But, as pointed out by Cornelli et al. (2006), institutional investors widely abstain from the when-issued market so that information asymmetries can still exist even if retail investors reveal all their information in this market.[12] Investors can still use the when-issued market as an information source during the bookbuilding period before submitting their demand. The results in the subsequent analysis on the demand behavior will therefore show whether institutional and retail investors' demand differs beyond the publicly available information in the when-issued market.

Before the beginning of the bookbuilding period, issuer and underwriters announce the issue volume, the price range within which investors can submit their bids, and the length of the bookbuilding period. The sample includes no issue in which either of these is subsequently revised. This is consistent with the evidence in Ljungqvist et al. (2003). Unlimited bids ("strike bids") by investors are therefore de facto limited by the upper bound of the initial bookbuilding range. Depending on issue volume and characteristics, the bookbuilding period lasts between 4 and 15 days for the sample IPOs. During this period, the underwriter and the issuer hold meetings with institutional investors (the "road-show"). Retail and institutional investors may submit a demand curve that indicates the number of shares they are willing to buy at a single or different prices in the bookbuilding range.[13] They have the right to revise or withdraw their bids at any point during the bookbuilding period, but their bids become legally binding at the end of this period.[14] The recorded demand is therefore not a mere indication of interest, but it represents investors' actual demand to which the underwriter can allocate the shares.

At the end of the bookbuilding period, the bookrunner in combination with the issuer uses the information about the bidding behavior to set the offer price, to determine an allocation schedule, and finally to allocate the shares to the bidders. This takes place one day before the start of public trading. Pricing and allocation decisions are completely in the underwriter's discretion with the only restriction that no price discrimination be allowed; all investors who submit bids at or above the offer price and subsequently receive allocations have to pay the offer price. Both demand by and allocation to different investors and groups of investors are recorded in the order book. This information makes it possible to analyze the underwriter's behavior in the bookbuilding process.

Since all sample issues are oversubscribed at least at the lower bound of the range, the underwriter has considerable discretion about how to allocate the shares to the bidders. The final offer price is lower than the market-clearing price in all 41 issues. There are 38 issues with excess demand at the upper bound of the price range. Table 1b shows that the offer price is set at the upper bound of the range in 20 issues, while it is set inside the range in 17 issues and at the lower bound of the range in 4 issues. The latter comprise the 3 issues with excess supply at the upper bound of the price range. The underwriter sets the price at the lower bound in these issues even though there is excess demand at least at two price steps above the lowest price. This is in line with the findings in Cornelli and Goldreich (2003).

[11] See e.g. Chemmanur and Fulghieri (1999).

[12] In fact, their paper shows that only high prices in the when-issued market are a good predictor of aftermarket prices, but low prices are not.

[13] According to the bankers, most investors, and in particular retail investors, submit a bid at one given price rather than a whole demand curve. In a randomly selected sub-sample of three IPOs, 10% of the retail investors and 17% of the institutional investors submit on average more than one bid in a given IPO.

[14] This is different from the bookbuilding procedure in the U.S., where the bids in the bookbuilding process are not binding from a legal perspective (though they might be from a reputational perspective).

Table 1b
Pricing.

	Sample
# of issuers	41
Priced at upper bound	20
Priced inside range	17
Priced at lower bound	4
Mean pricing (%)	70.2

Notes. The table exhibits how many sample issues are priced at the top of the bookbuilding range, inside the bookbuilding range, and at the bottom of the bookbuilding range, respectively. Pricing is the percentage ratio of the difference between the offer price and the lower bound of the bookbuilding range and the difference between the upper and the lower bound of the bookbuilding range.

3. Hypotheses development

Rock (1986) analyzes the consequences of the informational advantage that certain investors possess over the issuing firm and the rest of the investors with respect to the value of IPOs. These investors demand and are allocated shares in underpriced issues, while they abstain from bidding in overpriced issues. If issues are priced at their expected value and shares are allocated on a pro-rata basis, uninformed investors suffer a loss from receiving an overproportional share of overpriced IPOs. In order to keep these investors in the market, IPOs have thus to be underpriced.

Benveniste and Spindt (1989) explicitly introduce the role of an underwriter that elicits information from these informed investors, uses discretion in allocating shares, and repeatedly interacts with investors. As in the Rock (1986) setup, these investors have informational advantages over the issuing firm and the rest of the investors. They are also better informed than the underwriter. These investors are interested in a low offer price as their payoff is a function of the difference between the market and the offer price as well as the number of shares they are allocated. They are thus unwilling to reveal good information about the issuer unless they are rewarded for it.

Consequently, issuer and underwriter have to offer informed investors a higher payoff if they truthfully reveal their good information than if they lie. This is achieved by offering them a preferred allocation of shares, which in turn lowers the required level of underpricing. The simplified incentive compatibility constraint for each individual informed investor is:

$$q_g\left(P_g - P_g^o\right) \geqslant q_b\left(P_g - P_b^o\right), \tag{1}$$

where

q_g = shares allocated to an investor who truthfully reveals good information,
q_b = shares allocated to an investor who falsely reveals bad information,
P_g^o = offer price if the investor reveals good information,
P_b^o = offer price if the investor reveals bad information,
P_g = equilibrium market price when the investor has good information.

At the same time, the underwriter has to guarantee informed investors non-negative expected profits to induce them to participate, which leads to the following individual participation constraint in the single game:

$$P_b \geqslant P_b^o, \tag{2}$$

where P_b = equilibrium market price when the investor has bad information.

While the incentive mechanism can be used by issuing companies even in a one-period game, it becomes more powerful with the underwriter who repeatedly interacts with investors. In a repeated game, the underwriter can induce these investors to buy into issues with weak demand by threatening them to exclude them from allocations of underpriced issues in the future. While the incentive compatibility constraint is identical to the one-period game, the participation constraint thus changes in the multi-period game:

$$q_b\left(P_b^o - P_b\right) \leqslant L, \tag{3}$$

where $L =$ informed investor's expected profits from future IPOs.

In the one-period game, the issuer has to guarantee non-negative expected payoffs to investors in any given issue. By contrast, in the multi-period game, the underwriter only needs to guarantee non-negative payoffs across all issues. So investors may be asked to bear a loss in a given issue as long as they are compensated for this loss by gains in future issues.

The simplified Eqs. (1) to (3) from Benveniste and Spindt (1989) provide two testable empirical implications.

Empirical implication 1. The underwriter encourages informed investors to buy into issues with weak demand, which they would not buy into otherwise.

Eq. (3), the participation constraint in the multi-period game in Benveniste and Spindt (1989), suggests that informed investors may be asked to buy into eventually overpriced issues with weak demand as long as the incurred losses are more than offset by the expected profits from allocations in future IPOs. Informed investors are thus expected to be encouraged by the underwriter to submit orders when IPOs are about to fail. This implication can be tested in the given institutional setting by analyzing how the informed investors' demand builds up throughout the bookbuilding period, in particular for overpriced issues. Investors face a trade-off in deciding when to submit an order for an IPO. While the option to wait for more information would induce them to bid late, the anecdotal evidence of banks favoring early bids would induce them to bid early.[15] While there is thus no particular prediction on when demand is expected to be submitted, informed investors' demand over time should differ in eventually overpriced issues with weak demand. When the underwriter observes at a certain point of time in the bookbuilding period that the current demand projection for the end of the bookbuilding period will not be sufficient for the IPO to be sold, he should try to encourage informed investors to submit additional demand. We should thus see a significant increase in this investor group's demand in issues with weak demand after this point of time. A reasonable point of time for this projection is the half of the bookbuilding period, which will be used in the empirical test.

Empirical implication 2. The underwriter gives priority to informed investors in underpriced issues to compensate them for buying into issues with weak demand. In particular, the normalized rationing for these investors in underpriced issues is significantly higher than 1.

As a direct consequence of the intervention of informed investors in IPOs with weak demand and their incurred losses, the underwriter needs to compensate these investors in underpriced IPOs. This means that the underwriter actively uses his discretion and gives priority to informed investors in these IPOs. How does the underwriter give priority to these investors? As shown in the simplified incentive compatibility constraint in Eq. (1), Benveniste and Spindt (1989) focus on the allocations to informed investors by comparing the number of shares they are awarded when they truthfully or falsely reveal their information. However, Benveniste and Spindt (1989) do not provide an explicit framework for the test of Empirical implication 2, which focuses on the priority that certain investors receive over other investors in certain IPOs. Ceteris paribus, informed investors could receive more shares than other investors for two reasons: (1) they demand more shares than other investors, (2) the underwriter allocates more shares to their demand than to other investors' demand. Only the second alternative is consistent with Empirical implication 2 so it is important to analyze the allocation an investor receives relative to her demand. For this reason, the analysis focuses on the normalized

[15] It should be pointed out though that both arguments can be questioned. On the one hand, given that investors can withdraw their bids at any point of time during the bookbuilding period, they can bid early without losing the option to wait for more information. On the other hand, the mentioned anecdotal evidence has not been confirmed in existing empirical studies. Bankers argue that demand should build up linearly over time as most institutional investors submit their demand in the road-show meetings, which are evenly spaced throughout the bookbuilding period.

rationing, which captures the allocation to an investor in comparison to the benchmark of a strict pro-rata allocation. The normalized rationing for informed investors is thus expected to be significantly higher than 1 in underpriced issues.

A direct test of these implications requires data on the allocation to different investor groups as well as data on the demand by these investor groups, both during and at the end of the bookbuilding period. These are the data that are collected for the purpose of this study and that fill the gap left by the existing literature.

A crucial ingredient for the test of the empirical implications from Benveniste and Spindt (1989) is the existence of certain investors who are better informed about the value of an IPO than other investors, the issuer, and the underwriter. A natural proxy for informed investors are institutional investors who possess better resources to collect information about issue candidates than retail investors. It will first be verified whether institutional investors are indeed better informed than retail investors despite the existence of a when-issued market and whether these investors can thus serve as a proxy for informed investors in the subsequent tests.

Verification. Institutional investors are better informed than retail investors. They show a better ability in buying into underpriced issues and avoiding overpriced issues.

A straightforward empirical approach for this verification is to analyze whether institutional investors submit relatively more bids for underpriced than for overpriced issues. This approach follows the analysis of allocation patterns in Hanley and Wilhelm (1995) and Aggarwal et al. (2002) and allows to directly contrast the results. The final demand shares by institutional and retail investors at different prices within the bookbuilding range are a function of both the demand level (at the lowest price of the bookbuilding range) and the demand elasticities (within the bookbuilding range) by these two investor groups. In overpriced issues, informed investors should abstain from bidding and, if they bid, concentrate their bids on the lowest possible price in the bookbuilding range in order to minimize losses. This would result in a low demand level and a high demand elasticity. In underpriced issues, informed investors should demand a large quantity with a low demand elasticity in order to maximize gains. This implies that informed investors' demand elasticity as well as demand volume should differ significantly across overpriced and underpriced issues.

The implementation of this verification heavily relies on the classification of IPOs into underpriced and overpriced issues. A potential shortcoming is that the level of underpricing for a given IPO is also a function of the underwriter's pricing decision. It is therefore possible that informed investors know the true value of an IPO without knowing whether this IPO will be over- or underpriced as they do not know how the underwriter exactly sets the price. But, as outlined in the section before, the underwriter is not allowed to set the price outside the bookbuilding range for the sample companies. This provides a unique laboratory for a robustness check of whether institutional investors are indeed better informed. In this setting, informed investors are expected, independent of the underwriter's pricing decision, to demand more of the IPOs for which the market price is above the bookbuilding range than of those IPOs for which the market price is inside or even below the bookbuilding range.

4. Informativeness of investors' demand

The assumption in Benveniste and Spindt (1989) that some investors are better informed than other investors forms the basis for the verification. It states specifically that institutional investors can be considered being a natural proxy for informed investors. The first question is thus whether these investors are better informed than retail investors despite the existence of a when-issued market from which retail investors can obtain information before submitting their demand. The key question here is about the relative informativeness of retail and institutional investors and whether information asymmetry exists even when retail investors can benefit from external information sources. Investors' informativeness is analyzed by considering their demand curves for issues with different levels of underpricing. Two elements of the bidding behavior deserve particular attention: Demand elasticity and demanded quantity. While the demand elasticity measures the relative change of the demand volume

between the lower and the upper end of the bookbuilding price range, the demanded quantity represents the absolute demand volume at different prices within the range. In absence of a theory that allows a joint estimation, these two elements are first considered in two separate analyses. Finally, both analyses are combined and the relative demand shares are calculated at different points in the bookbuilding range.

In the subsequent comparative analysis, issues are sorted into three groups based on their level of underpricing. The classification is similar to that in Aggarwal et al. (2002). There are 11 overpriced issues, which belong to the first group. The second group comprises 14 issues with underpricing between 0 and 25%. The remaining 16 issues with underpricing larger than 25% belong to the third group. In the robustness section, the results are discussed for the alternative classification that is based on the relation between the bookbuilding range and the market price.

4.1. Elasticity of demand

The aggregate elasticity of demand for different investor groups is computed as the ratio of the percentage change in quantity demanded and the percentage change in price. The reference points are the lower and the upper limit of the bookbuilding range[16]:

$$\epsilon = \left| \frac{\Delta Q_{\text{Upper–LowerEnd}}}{Q_{\text{LowerEnd}}} \Big/ \frac{\Delta P_{\text{Upper–LowerEnd}}}{P_{\text{LowerEnd}}} \right|.$$

The overall mean (median) elasticity reported in Table 2a amounts to 0.6686 (0.3442), which shows that demand is not perfectly elastic. This result is consistent with Bagwell (1992) for Dutch auction repurchases, Kandel et al. (1999) for nondiscriminatory IPO auctions, and Liaw et al. (2001) for discriminatory IPO auctions.

The distribution of investors' demand over the bookbuilding range is one measure for their aggressiveness: The higher the demand elasticity, the lower their aggressiveness. This is essentially one of the key measures used in the auction literature, such as in Nyborg et al. (2002), to capture bidders' aggressiveness.[17] If investors have information on the value of an issue, demand elasticity is expected to decrease with the issue's initial return. This is analyzed by comparing the demand elasticity for the three investor groups for issues with different initial returns.

Table 2b shows that aggregate institutional investors' elasticity is substantially higher than aggregate retail investors' elasticity. The mean for all 41 IPOs amounts to 0.8444 for institutional investors and 0.1187 for retail investors. The institutional investors' demand is significantly more elastic than the retail investors' demand as well for the different levels of initial returns. Whereas institutional investors' elasticity decreases monotonically and significantly with the initial return, this does not hold consistently for retail investors: Their demand elasticity is not statistically different for overpriced issues and for issues with underpricing between 0 and 25%. Retail investors as a group become therefore more vulnerable to the winner's curse, as their relative demand increases with higher prices, in particular for overpriced issues. While the overall analysis shows a steady decrease of the elasticity of institutional demand for more issues with higher initial returns, it is noteworthy that their demand elasticity even for highly underpriced issues is larger than zero. If these investors were fully informed and truthfully revealed their information, the demand elasticity should be zero for these issues. This implies that at least one of these two conditions is not fulfilled.

[16] For a robustness check, this analysis is repeated without those bids at the upper limit of the bookbuilding range. The results do not change.

[17] These papers use the standard deviation of individual bidders' demand schedules in lack of a given price range in which demand can be submitted.

Table 2a
Demand elasticity for investors groups.

	Overall	Underpricing (*UP*)		
		L: $UP < 0\%$	*M*: $0\% \leqslant UP \leqslant 25\%$	*H*: $UP > 25\%$
Number of issues	41	11	14	16
All				
Mean	0.6686	1.3225	0.6081	0.1598
Median	0.3442	1.0991	0.3634	0.1469
STD	0.7084	0.7575	0.6144	0.0637
Institutional				
Mean	0.8444	1.7069	0.7233	0.2355
Median	0.4267	1.3403	0.4551	0.2494
STD	0.8118	0.8102	0.6643	0.0747
Retail				
Mean	0.1187	0.2388	0.1185	0.0089
Median	0.0412	0.1001	0.0462	0.0027
STD	0.1751	0.2444	0.1441	0.0187
Dom. inst.				
Mean	0.8157	1.7707	0.7480	0.0418
Median	0.3085	1.4152	0.4791	0.0175
STD	0.9906	0.9911	0.8771	0.0513
For. inst.				
Mean	0.8945	1.8218	0.7045	0.3294
Median	0.4839	1.3456	0.4873	0.3284
STD	0.8832	1.0910	0.5963	0.0947

Notes. The table reports the demand elasticity of all investors and all investor groups. Demand elasticity is the ratio of the percentage change in demand and the percentage change in price between the lower and the upper end of the bookbuilding range: $\varepsilon = |(\Delta Q_{\text{Upper-LowerEnd}}/Q_{\text{LowerEnd}})/(\Delta P_{\text{Upper-LowerEnd}}/P_{\text{LowerEnd}})|$. Figures are reported for all sample issues and for three groups, in which issues are sorted by their initial return.

Table 2b
Wilcoxon *z*-statistics.

	L/*M*	*M*/*H*	*L*/*H*
All	2.64***	3.07***	5.07***
Institutional	3.39***	3.09***	5.99***
Retail	1.48	3.19***	3.11***
Domestic institutional	2.82***	3.41***	5.78***
Foreign institutional	3.12***	2.62***	4.52***

Notes. The table reports Wilcoxon *z*-statistics for the pair-wise comparison of the average demand elasticity for each investor group in issues with low underpricing (*L*), issues with medium underpricing (*M*), and issues with high underpricing (*H*). The null hypothesis is that the demand elasticity of the respective investor group is not different across issues with different levels of underpricing.

*** Significance at the 1 percent level.

4.2. Volume of demand

The volume of demand is captured by the level of subscription.[18] Informed investors are expected to foresee an issue's initial return and consequently submit more bids in issues with higher levels of underpricing. Tables 3a and 3b report the results for all investors and for all return groups at the lower end of the bookbuilding range. The evidence is consistent for all investors: The higher the initial return of the issue, the more shares are demanded. In general, subscription levels are highly skewed. While nine IPOs are subscribed less than two times at the end of the bookbuilding

[18] Unless noted otherwise, subscription represents throughout the paper the ratio of the number of shares demanded at the lower end of the bookbuilding range and the number of shares supplied.

Table 3a
Subscription for investors groups.

	Overall	Underpricing (*UP*)		
		L: $UP < 0\%$	*M*: $0\% \leqslant UP \leqslant 25\%$	*H*: $UP > 25\%$
Number of issues	41	11	14	16
All				
Mean	25.50	8.90	13.90	47.08
Median	14.38	4.22	9.98	49.57
STD	26.00	10.61	13.93	27.11
Institutional				
Mean	17.31	6.38	9.60	31.57
Median	10.62	1.99	6.96	30.15
STD	16.45	8.47	8.62	15.80
Retail				
Mean	8.19	2.51	4.29	15.51
Median	4.35	1.13	1.32	14.59
STD	10.47	2.38	6.56	12.51
Dom. inst.				
Mean	5.99	2.35	3.64	10.56
Median	3.75	1.52	3.43	10.62
STD	6.11	2.32	3.70	6.85
For. inst.				
Mean	11.32	4.04	5.96	21.01
Median	7.37	1.13	4.30	20.36
STD	10.82	6.75	5.85	9.30

Notes. The table reports the level of subscription for all investors and all investor groups. Subscription is the ratio of the number of shares demanded at the lower end of the bookbuilding range and the number of shares supplied. Figures are reported for all sample issues and for three groups, in which issues are sorted by their initial return.

Table 3b
Wilcoxon *z*-statistics.

	L/*M*	*M*/*H*	*L*/*H*
All	1.01	4.29***	5.09***
Institutional	0.93	4.80***	5.35***
Retail	0.94	3.13***	4.05***
Domestic institutional	1.07	3.50***	4.44***
Foreign institutional	0.75	5.37***	5.49***

Nots. The table reports Wilcoxon *z*-statistics for the pair-wise comparison of the average subscription for each investor group in issues with low underpricing (*L*), issues with medium underpricing (*M*), and issues with high underpricing (*H*). The null hypothesis is that the subscription of the respective investor group is not different across issues with different levels of underpricing.

*** Significance at the 1 percent level.

period, subscription reaches very high levels for small and profitable issues.[19] This general finding is independent of the choice of the point of the demand curve; the results for the lower and the upper end of the bookbuilding range are qualitatively the same.

The analyses of demand elasticity and volume of demand show that both institutional and retail investors adjust their demand to the initial return of a new issue. Retail investors primarily decide whether to submit a bid or not and, if so, submit a highly inelastic demand curve independent of the initial return of a new issue. In contrast, institutional investors adjust their demand curve to the initial return in case they decide to submit a bid. The open question is how the relative composition of demand between the different investor groups is determined by these strategies. This relative composition of demand conditional on the initial return of a new issue is at the heart of the winner's curse and will be analyzed in the next section.

[19] The maximum subscription levels exceeds 100.

Following the intuition in Hodrick (1999), we also investigate the predictability of both demand elasticity and quantity by taking into account further firm-specific factors beyond the level of underpricing.[20] The regression results, which are available upon request, show that the level of underpricing is by far the most important and only significant coefficient. Therefore, it seems to be appropriate to concentrate on a comparative analysis in this and the previous section.

4.3. Distribution of demand at different price steps

Each investor group's percentage demand share is now computed as the ratio of the specific investor group's demand and the total demand by all investor groups. Tables 4a and 4b present the relative demand shares for the aggregate groups of institutional and retail investors as well as for the institutional sub-groups. These average shares are reported at three points within the bookbuilding range: the lower end, the middle point, and the upper end. Overall, institutional investors demand about 70% and retail investors about 30% of the shares in IPOs. The average demand share for institutional investors decreases only slightly and statistically insignificantly for higher prices in the bookbuilding range.

This analysis is repeated for the different return groups, and the results are shown in Table 5. The average demand share for institutional investors at the upper end of the bookbuilding range rises from 63.37% for overpriced issues to 72.58% for highly underpriced issues. This difference is significant

Table 4a
Average percentage demand at different prices in the bookbuilding range.

	Lower end	Middle	Upper end
Institutional			
Mean	72.76%	71.25%	69.77%
Median	70.76%	69.47%	68.51%
STD	14.29%	14.67%	15.31%
Retail			
Mean	27.24%	28.75%	30.23%
Median	29.24%	30.53%	31.49%
STD	14.29%	14.67%	15.31%
Dom. inst.			
Mean	25.20%	25.08%	24.41%
Median	23.07%	22.97%	23.07%
STD	10.43%	10.78%	10.80%
For. inst.			
Mean	47.56%	46.17%	45.35%
Median	44.33%	41.72%	41.46%
STD	20.00%	20.93%	21.20%

Note. The table reports the average relative demand by investor group in the 41 sample IPOs at different points of the bookbuilding range: its lower end, its middle, and its upper end.

Table 4b
Wilcoxon *z*-statistics.

	Lower end/middle	Middle/upper end	Lower end/upper end
Institutional/retail	0.47	0.33	0.80
Domestic institutional	0.07	0.26	0.19
Foreign institutional	0.37	0.11	0.48

Notes. The table reports Wilcoxon *z*-statistics for the pair-wise comparison of the average percentage demand for each investor group at the lower end, the middle, and the upper end of the bookbuilding range. The null hypothesis is that the average demand of the respective investor group is not different at different points of the bookbuilding range.

[20] These factors comprise the offer volume, the free-float, the share of the capital increase, the total assets, and a dummy variable to distinguish non-high-tech and high-tech companies.

Table 5
Average percentage demand at different prices in the bookbuilding range for different return groups.

Number of issues	L: $UP < 0\%$	11		M: $0\% \leqslant UP \leqslant 25\%$	14		H: $UP > 25\%$	16		z-statistics Upper end
	Lower end	Middle	Upper end	Lower end	Middle	Upper end	Lower end	Middle	Upper end	$L - H$
Institutional										
Mean	68.41%	65.50%	63.37%	75.46%	73.84%	71.58%	73.38%	72.93%	72.58%	1.66*
Median	67.96%	66.05%	63.76%	70.30%	69.71%	68.31%	72.43%	71.99%	71.62%	
STD	13.49%	14.66%	15.88%	14.78%	14.66%	15.30%	14.60%	14.54%	14.57%	
Retail										
Mean	31.59%	34.50%	36.63%	24.54%	26.16%	28.42%	26.62%	27.07%	27.42%	1.66*
Median	32.04%	33.95%	36.24%	29.70%	30.29%	31.69%	27.57%	28.01%	28.38%	
STD	13.49%	14.66%	15.88%	14.78%	14.66%	15.30%	14.60%	14.54%	14.57%	
Dom. inst.										
Mean	28.46%	28.79%	27.61%	27.08%	26.51%	25.26%	21.31%	21.27%	21.48%	1.54
Median	26.62%	30.13%	27.87%	27.19%	26.76%	25.79%	22.34%	21.77%	22.01%	
STD	11.99%	12.30%	12.45%	12.65%	13.24%	13.62%	5.33%	5.42%	5.43%	
For. inst.										
Mean	39.95%	36.70%	35.76%	48.39%	47.33%	46.32%	52.07%	51.66%	51.11%	2.01**
Median	38.60%	26.07%	25.36%	37.69%	36.81%	36.36%	49.18%	48.42%	47.74%	
STD	19.44%	20.86%	20.97%	23.07%	23.50%	24.06%	16.98%	17.32%	17.32%	

Notes. The table reports the average percentage demand by investor group in the 41 sample IPOs at different points of the bookbuilding range: its lower end, its middle, and its upper end. Figures are reported for three groups, in which issues are sorted by their initial return. The last column of the table reports Wilcoxon z-statistics for the comparison of the average percentage demand by each investor group at the upper end of the bookbuilding range in issues with low underpricing (L) and issues with high underpricing (H). The null hypothesis is that the average demand of the respective investor group is not different across issues with these two different levels of underpricing.

* Significance at the 10 percent level.

** Idem, 5 percent level.

at the 10% level. This means that institutional investors better adjust their demand behavior than retail investors by lowering their demand quantity and increasing their demand elasticity for bad issues. This overall significant effect arises as a combination of two patterns that are insignificant if considered separately: (1) Institutional investors' demand share tends to increase with underpricing. At the lower end of the bookbuilding range, the average amounts to 68.41% for overpriced issues and 73.38% for highly underpriced issue. (2) The difference between institutional investors' demand shares at the lower and the upper end of the bookbuilding range tends to be most pronounced for overpriced issues. Whereas it decreases from 68.41% to 63.37% for these issues, it only decreases from 73.38% to 72.58% for highly underpriced issues. The result for the combination of these two effects supports the predictions of the winner's curse hypothesis and it illustrates the two mechanisms that lead to this outcome.

While the aggregate group of institutional investors demonstrates a superior ability to detect underpriced issues than retail investors, the behavior of the two institutional sub-groups differs substantially. Foreign institutional investors show the best ability to adjust their demand behavior to the level of underpricing. Whereas their demand share is below 40% in overpriced issues, it rises to more than 50% in highly underpriced issues (statistically significant at the 5% level). On the contrary, the demand pattern for domestic institutional investors looks similar to that for retail investors. Their demand share falls from about 28% for overpriced issues to 21% for highly underpriced issues. This is a very surprising result, as domestic institutional investors are closest to the issuing company and should therefore be able to receive the most reliable information. The underlying reasons for this observation will be considered in detail in the subsequent analysis of the dynamics of demand over time.

This section verifies that institutional investors are better informed than retail investors and can thus serve as a proxy for informed investors in the tests of the empirical implications. This is solely due to foreign institutional investors, whereas domestic institutional investors submit demand in a similar way as retail investors. The next section analyzes the underlying reasons for this puzzling result by considering the evolution of demand over time and testing the first empirical implication that is derived from Benveniste and Spindt (1989).

5. Underwriter intervention

The first empirical implication states that informed investors are encouraged to buy into issues with weak demand. In the analysis so far there has been no explicit function for an underwriter and the use of discretion. In particular, the demand outcome at the end of the bookbuilding period is assumed to be exogenously determined by the investors. In Benveniste and Spindt (1989), the bookbuilding mechanism allows the underwriter to observe the evolution of demand throughout the bidding period and possibly to intervene. In contrast to the issuers, for which the IPO is one of the few major interactions with investors in capital markets, the underwriter repeatedly interacts with these investors. An underwriter can therefore use his leverage to induce informed investors to buy issues with weak demand as a quid pro quo for substantial allocations in underpriced issues in the future. This pooling mechanism may serve two purposes: (1) The underwriter can mitigate the winner's curse faced by uninformed investors. (2) The underwriter can decrease the issuer's risk of withdrawing an issue in the bookbuilding period due to weak demand. The previous section shows that institutional investors are better informed than retail investors. Because of their informational advantage and lower transaction costs, institutional investors should be the easiest group to be asked to be "a friend in need" for these "lemons." The underwriter may communicate with these investors in cases of weak demand and encourage them to submit (further) bids. Interventions by the underwriter should therefore be observable in the demand evolution over time.

The underwriter provided daily net demand data for both domestic and foreign institutional investors as well as retail investors. Net demand is the number of shares for which new bids are submitted minus the number of shares for which bids are withdrawn on each day during the book-

building period.[21] To compare bookbuilding periods with different lengths, time deciles are created for each bookbuilding period. Then for each decile and each issue the number of shares is calculated for which bids are submitted.[22] For each issue, the total amount of shares demanded is normalized to be 100.

Fig. 1 illustrates how the order book is built over time. Issues are classified in two groups: those with strong demand and those with weak demand. In 29 of the 41 sample issues, demand exceeds supply in the first two deciles of the bookbuilding period. These are the issues with strong demand. The remaining 12 cases in which demand exceeds supply not before the fifth decile are classified as issues with weak demand.[23] The average subscription level for these issues at the end of the bookbuilding period amounts to 2.07 with an average underpricing of −2.06% (median: −0.53%). Among these are the three issues for which demand does not exceed supply at the upper bound of the range at the end of the bookbuilding period. Fig. 1 provides evidence that retail and foreign institutional investors' demand builds up linearly independent of the strength of the overall demand in an issue. Domestic institutional investors behave in the same way as retail and foreign institutional investors for issues with strong demand. But domestic institutional investors concentrate more than 45% of their bids in the last two deciles of the bookbuilding period for issues with weak demand.[24] This pattern is even more pronounced for those issues with the weakest demand. In the three issues in which demand exceeds supply only in the last decile, domestic institutional investors submit on average 66.20% (median: 63.11%) of their demand in the last two deciles, i.e. in the last 24 to 48 hours before the offer.

Table 6 analyzes this observation more formally in a regression model. The dependent variable is the share of an investor group's demand that is submitted in the second half of the bookbuilding period. This variable is regressed on three variables of interest, which capture the demand for an IPO and therefore the risk of withdrawal for this IPO, and a number of control variables. The first of the three variables of interest is a dummy variable that takes a value of one if supply exceeds demand after the first half of the bookbuilding period and zero otherwise.[25] The second variable of interest is the log of the subscription level after the half of the bookbuilding period.[26] The third variable of interest is very similar to the second variable of interest, but it excludes the demand by the respective investor group in the dependent variable in the calculation of the subscription level. The motivation for this variable is to rule out the possibility of a mean reversion in demand that is unrelated to the underwriter discretion, i.e. a high fraction of late bids naturally following from a low fraction of early bids.

The control variables are LNVAL, the log of the offer value, which is the number of offered shares multiplied by the offer price. FREEFLOAT is included in order to capture the share of the company that is publicly traded after the IPO. This figure is announced before the beginning of the bookbuilding period. CAPINC is the percentage of the issue volume that comes from a capital increase and flows to the issuing company and not the pre-IPO owners. HIGHTECH is a dummy variable that takes the value of 1 for high-tech companies and 0 for traditional companies. Finally, CO-LEAD is a dummy variable that takes a value of one if the sample underwriter has a co-lead underwriter for the respective IPO and a value of zero otherwise. It is included to test whether demand patterns are different in IPOs in which the sample bank is the only lead underwriter and in IPOs in which the sample bank has other co-lead underwriters. This is important in order to analyze whether the demand patterns are specific to the sample underwriter. The expectation is that investors who are asked by the underwriter to submit further demand in issues with weak demand significantly increase their demand in the second

[21] The net demand per day is never negative in any of the sample issues.

[22] In cases in which the bookbuilding period is longer or shorter than ten days, the number of days is divided by ten and the appropriate fraction of the demand on a specific day is used to calculate the demand in each decile, e.g. for a bookbuilding period of five days, the first and second decile each comprise half of the demand on the first day.

[23] There are no issues in which demand exceeds supply in the third or fourth decile.

[24] For a bookbuilding period of five days, this means that they submit more than 45% of their demand on the last day.

[25] For bookbuilding periods with an odd number of days, 50% of the demand on the middle day is taken into account for the demand in the first half.

[26] The motivation for the choice of the log expression is the small number of outliers with final subscription levels above 100.

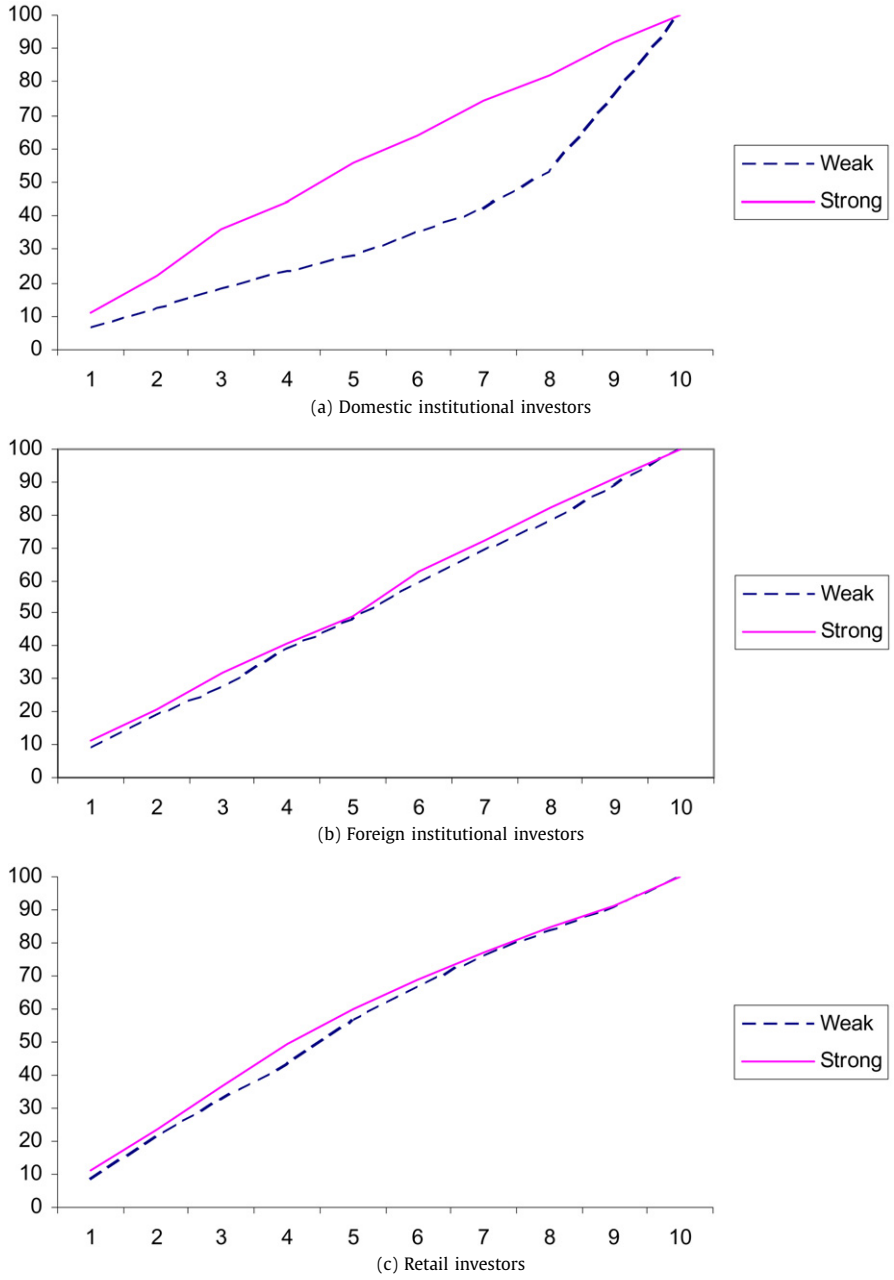

Fig. 1. Evolution of investor demand over time. The figure shows the cumulative distribution function of the evolution of demand over time. The bookbuilding period of each issue is split into deciles. For each decile, the number of demanded shares is calculated. Then the average is taken for two groups: issues with weak demand and issues with strong demand. This classification is based on the decile of the bookbuilding period in which demand first exceeds supply for an issue. In 29 issues demand exceeds supply in the first two deciles (strong), in the remaining 12 issues demand exceeds supply not before the fifth decile (weak).

Table 6
OLS regression: Demand over time by institutional and retail investors.

	Late demand								
	Dom. inst.			For. inst.			Retail		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
INTERCEPT	0.258	0.478	0.458	0.267	0.297	0.356	0.354	0.386	0.262
	(0.53)	(1.04)	(1.01)	(0.68)	(0.74)	(1.00)	(0.99)	(1.07)	(0.67)
LNVAL	−0.016	−0.024	−0.025	−0.022	−0.023	−0.029	−0.029	−0.030	−0.022
	(0.45)	(0.71)	(0.72)	(0.75)	(0.79)	(1.07)	(1.07)	(1.11)	(0.73)
FREEFLOAT	0.050	0.020	−0.001	0.167	0.154	0.170	0.171	0.155	0.168
	(0.18)	(0.08)	(0.01)	(0.80)	(0.75)	(0.84)	(0.83)	(0.76)	(0.83)
CAPINC	0.194	0.244	0.252	0.071	0.072	0.052	0.053	0.054	0.071
	(1.30)	(1.77)*	(1.84)*	(0.62)	(0.63)	(0.48)	(0.49)	(0.50)	(0.62)
HIGHTECH	0.010	0.066	0.067	0.060	0.062	0.057	0.057	0.059	0.060
	(0.10)	(0.73)	(0.74)	(0.83)	(0.86)	(0.79)	(0.80)	(0.83)	(0.83)
CO-LEAD	−0.113	−0.078	−0.062	0.013	0.014	0.032	0.031	0.031	0.014
	(1.09)	(0.83)	(0.66)	(0.17)	(0.18)	(0.42)	(0.42)	(0.42)	(0.18)
= 1 if *supply* > *demand* (*half of BB*)	0.277			−0.001			−0.004		
	(2.82)***			(0.02)			(0.05)		
LNS all investors (*half of BB*)		−0.090			−0.006			−0.006	
		(3.40)***			(0.30)			(0.33)	
LNS other investors (*half of BB*)			−0.099			0.001			0.001
			(3.55)***			(0.03)			(0.09)
Adjusted R^2	0.27	0.37	0.39	0.12	0.13	0.12	0.12	0.12	0.12
N	41	41	41	41	41	41	41	41	41

Notes. Late demand is the fraction of demand by each investor group that is submitted in the second half of the bookbuilding period. *LNVAL* is the log of the offer volume, which is the number of offered shares multiplied by the offer price. *FREEFLOAT* is the share of the company that is publicly traded after the IPO. *CAPINC* is the percentage of the issue volume that comes from a capital increase. *HIGHTECH* is a dummy variable, which takes the value 1 for high-tech companies and 0 for traditional companies. *CO-LEAD* is a dummy variable that takes a value of one if the sample underwriter has a co-lead underwriter for the respective IPO and a value of zero otherwise. *LNS all investors* (*half of BB*) is the log of the subscription level by all investors after the first half of the bookbuilding period. *LNS other investors* (*half of BB*) is the respective value for all investor groups except for the group in the dependent variable. *t*-statistics (in parentheses) are adjusted for heteroskedasticity and the small sample size by the HC3 variant, as proposed by MacKinnon and White (1985).

* Significance at the 10 percent level.

*** Idem, 1 percent level.

half of the bookbuilding period when their additional demand becomes crucial for the placement success.

The first three columns in Table 6 report the results for the analysis of the demand by domestic institutional investors. The results in column (1) show that the demand that is submitted by these investors in the second half of the bookbuilding period increases significantly in those issues in which supply exceeds demand after the first half of the bookbuilding period. These results are confirmed by the results in column (2) that show that the subscription level after the first half is negatively and significantly related to the demand that domestic institutional investors submit in the second half. The results are also confirmed by the results in column (3) that show the same pattern as in column (2) for the subscription level at the half of the bookbuilding period that excludes the demand by domestic institutional investors. Both the coefficients and the significance levels hardly change between column (2) and column (3). These results suggest that domestic institutional investors significantly increase their demand when the current demand during an IPO bookbuilding period is not sufficient to place this issue.

These three regressions are subsequently repeated for foreign institutional investors and retail investors. The results are reported in columns (4) to (9). In contrast to the findings for domestic institutional investors, neither the dummy variable nor the subscription levels after the first half have a significant influence on the demand shares by these two investor groups in the second half. In particular, the lack of significance of the dummy variable for foreign institutional investors suggests that these investors are not contacted by the underwriter if additional demand needs to be generated.

These regression results for the dynamic demand behavior are consistent with the static analysis of the final demand shares of these investors: The average demand share for domestic institutional investors at the offer price in issues with weak demand amounts to 28.05% in comparison to 23.65% in issues with strong demand. For foreign institutional investors the opposite holds: Their average demand share in issues with weak demand amounts to 41.62% in comparison to 48.90% in issues with strong demand.[27] This suggests that domestic institutional investors submit additional bids in issues with weak demand and are "a friend in need" to the underwriter. These investors insure the underwriter against the risk of withdrawing an issue, or stated differently, the underwriter holds a quasi-put option with domestic institutional investors serving as the implicit writers of the option.[28]

The results suggest that domestic institutional investors increase their demand in issues with weak initial demand that otherwise might be withdrawn. The bookbuilding procedure generates sufficient final demand even in issues for which investors are hesitant to submit bids. It therefore reduces the issuers' uncertainty about the placement success and allows a larger number of companies to go public.[29] In the next section we test the second empirical implication by analyzing how these bookbuilding patterns over time are reflected in the way the underwriter matches allocation and demand.

6. The matching of allocation and demand

As derived in the second empirical implication, investors who help the underwriter to guarantee the placement success in issues with weak demand are expected to be rewarded by better allocations in underpriced issues. The results so far suggest that institutional and mainly foreign institutional investors show a better ability than retail investors to adjust their demand to the initial return of a new issue. The significance of this result is noteworthy for two reasons. First, retail investors are less well informed than institutional investors despite the existence of a when-issued market. This is consistent with the fact that institutional investors abstain from these when-issued markets and thus

[27] Both differences are statistically significant (one-sided test) with z-statistics of 1.41 and 1.42, respectively.

[28] The substantial increase of institutional investors' demand also helps to mitigate the winner's curse faced by uninformed investors. After the first half of the bookbuilding period (i.e. before the demand increase), the average demand shares of institutional and retail investors in issues with weak demand are 59% and 41%, respectively.

[29] None of the sample issues had to be withdrawn during the sample period. An open question is whether this procedure is optimal. To answer this question, it would be necessary to analyze the consequences of going public on all the agents, in particular the issuer.

not reveal their information before the IPO. Second, the evidence suggests that domestic institutional investors intentionally buy into issues with weak demand and help to guarantee their placement success. How does the underwriter match allocation and demand given this evidence? The question is analyzed in two steps. First, the actual allocation is documented. Second, this is compared to a strict pro rata allocation.

6.1. The allocation of shares and profits

Tables 7a and 7b report the relative shares that different investor groups obtain in the allocation process. Overall, the allocation composition between institutional and retail investors widely follows a 70/30 pattern. These figures coincide in magnitude with those reported in Hanley and Wilhelm (1995), Ljungqvist and Wilhelm (2002), and Aggarwal et al. (2002). On average, domestic institutional investors receive about 40% and foreign institutional investors receive about 60% of the institutional allocations. Furthermore, the allocation to both the institutional and retail investors are similar to their overall demand, as reported before.

The allocation to investor groups is calculated for the different return groups. The overall institutional share is lowest for overpriced issues with 66.25%, it increases to 70.81% for moderately and 76.67% for highly underpriced issues. Institutional allocation in highly underpriced issues is significantly (at the 5% level) larger than in overpriced issues. Whereas the allocations to domestic institutional investors are almost constant across the different return groups, allocation shares of for-

Table 7a
Average percentage allocation to investor groups.

	Overall	Underpricing (*UP*)		
		L: $UP < 0\%$	*M*: $0\% \leqslant UP \leqslant 25\%$	*H*: $UP > 25\%$
Number of issues	41	11	14	16
Institutional				
Mean	71.87%	66.25%	70.81%	76.67%
Median	70.86%	61.19%	71.15%	73.39%
STD	13.83%	15.29%	14.55%	11.03%
Retail				
Mean	28.13%	33.75%	29.19%	23.33%
Median	29.14%	38.81%	28.85%	26.61%
STD	13.83%	15.29%	14.55%	11.03%
Dom. inst.				
Mean	28.54%	28.91%	28.91%	27.96%
Median	29.56%	28.97%	29.79%	30.40%
STD	10.97%	10.00%	14.46%	8.51%
For. inst.				
Mean	43.33%	37.34%	41.90%	48.71%
Median	42.66%	37.41%	38.58%	45.97%
STD	19.19%	19.45%	22.71%	14.96%

Notes. The table reports the relative allocation to different investor groups in the 41 sample IPOs. Figures are reported for all sample issues and for three return groups, in which issues are sorted by their initial return.

Table 7b
Wilcoxon *z*-statistics.

	L/*M*	*M*/*H*	*L*/*H*
Institutional/retail	0.76	1.23	1.94**
Domestic institutional	0.00	0.21	0.26
Foreign institutional	0.73	0.95	1.63

Notes. The table reports Wilcoxon *z*-statistics for the pair-wise comparison of the average allocation to each investor group in issues with low underpricing (*L*), issues with medium underpricing (*M*), and issues with high underpricing (*H*). The null hypothesis is that the allocation to the respective investor group is not different across issues with different levels of underpricing.
** Significance at the 5 percent level.

Table 8a
Investor profits: Actual profits by investor group.

Number of issues	Overpriced 11		Underpriced 26		Overall 37	
	EUR mil.	% of total	EUR mil.	% of total	EUR mil.	% of total
Institutional	−60.62	62.45	975.85	70.65	915.23	71.27
Dom. inst.	−23.96	24.68	358.82	25.98	334.86	26.08
For. inst.	−36.66	37.77	617.04	44.67	580.37	45.20
Retail	−36.45	37.55	405.34	29.35	368.89	28.73
Total	−97.08	100	1381.20	100	1284.12	100

Note. Profits are calculated by multiplying the number of allocated shares by the difference of the closing price of the first trading day and the offer price.

Table 8b
Investor profits: Hypothetical profits by investor group under strict pro-rata allocation.

Number of issues	Overpriced 11		Underpriced 26		Overall 37	
	EUR mil.	% of total	EUR mil.	% of total	EUR mil.	% of total
Institutional	−63.36	65.26	1,041.95	75.44	978.59	76.21
Dom. inst.	−22.27	22.94	292.85	21.20	270.59	21.07
For. inst.	−41.09	42.33	749.09	54.24	708.00	55.14
Retail	−33.72	34.74	339.25	24.56	305.53	23.79
Total	−97.08	100	1381.20	100	1284.12	100

Note. Profits are calculated by multiplying the number of shares that the investors groups would have received under a strict pro rata rationing by the difference of the closing price of the first trading day and the offer price.

eign institutional investors rise weakly significantly from 37.34% in overpriced to 48.71% in highly underpriced issues. This confirms the evidence in Aggarwal et al. (2002): The relative allocation of shares to institutional investors is higher in underpriced issues than in overpriced issues.

Apart from the allocation of shares, the second important dimension is the allocation of profits. Investors' profits are calculated as the factor of the difference between the closing price of the first trading day and the offer price and the number of allocated shares. Table 8a exhibits that institutional investors receive 71.27% of the overall profits. In overpriced issues they bear 62.45% of the overall losses, which are relatively small in comparison to the profits. In underpriced issues they participate in 70.65% of the gains. Retail investors earn EUR 368.89 million from demanding in the sample issues. Profits for both institutional and retail investors are significantly positive (at the 1% level). Given the significant skewness in money gains, the analysis is repeated without any of the five most profitable issues. The monetary profit for each of the investor groups remains significant.

6.2. Benchmark for the allocation of shares and profits

The actual allocation of shares and profits is compared to a hypothetical strict pro-rata allocation to analyze which groups benefit from the underwriter's discretion.

6.2.1. Profits

Investors' hypothetical profits are calculated under the assumption that the underwriter chose the actual offer price, but used a strict pro rata allocation at that offer price. The results are reported in Table 8b. Institutional investors would receive EUR 978.58 million or 76.21% of the overall profits under this hypothetical mechanism, while retail investors would earn EUR 305.53 million or 23.79% from demanding in the sample issues. The comparison of Tables 8a and 8b illustrates which investor groups benefit or lose from the underwriter's discretionary power in allocating the shares. In comparison to a strict pro rata allocation, the underwriter uses the discretion in the bookbuilding mechanism

to shift about EUR 120 million from foreign institutional investors in equal parts to domestic institutional investors and retail investors. This is a striking observation given the earlier evidence that foreign institutional investors show the best ability to condition their demand on the initial return of a new issue.

6.2.2. Shares

A strict pro-rata allocation at the actual offer price is also used as a hypothetical benchmark for the allocation of shares. The tool for the comparison is therefore the same as in Cornelli and Goldreich (2001) who introduce the notion of normalized rationing. This is defined as the ratio of percentage allocation to percentage demand. More formally, the normalized rationing for each investor group k is calculated as:

$$NR_k = \frac{\frac{Allocation_k}{Allocation_{Total}}}{\frac{Demand_k}{Demand_{Total}}},$$

where $Allocation_k$ is the number of shares that is allocated to investor group k, $Demand_k$ represents the number of shares that investor group k demands at the IPO offer price, and $Allocation_{Total}$ and $Demand_{Total}$ is the respective allocation and demand by all investor groups.

A strict pro-rata allocation for institutional and retail investors is as follows:

$$\frac{Allocation_{Total}}{Demand_{Total}} = \frac{Allocation_{Institutional}}{Demand_{Institutional}} = \frac{Allocation_{Retail}}{Demand_{Retail}}.$$

In a strict pro-rata allocation, normalized rationing would be equal to 1.00. In order to assess whether an investor group obtains favorable allocation, the normalized rationing for this group is compared to the strict pro rata allocation.

The results in Tables 9a and 9b show that the normalized rationing for institutional and retail investors as aggregate groups is not statistically different from one. Moreover, the means for the two groups are not different from each other with a respective t-statistic of 1.22. Whereas institutional investors are favored in issues with underpricing levels higher than 25%, retail investors obtain better allocations in issues with underpricing levels between 0 and 25%.[30] The figures do not support the commonly held belief that institutional investors are treated more favorably than retail investors in the bookbuilding process.

The favorable treatment for institutional investors in highly underpriced issues is exclusively due to the favorable treatment for domestic institutional investors. The normalized rationing for these investors amounts to 1.1281 for moderately underpriced and 1.2787 for highly underpriced issues, and both values are significantly different from one at the 1% level. In contrast, in no return group, does the normalized rationing for foreign institutional investors reach values above 1.00. The normalized rationing for these investors is even significantly less than 1.00 in moderately underpriced issues.[31] The results provide evidence that domestic institutional investors are significantly favored over foreign institutional investors. This is consistent with the findings in Cornelli and Goldreich (2001) and Jenkinson and Jones (2004).

We next control for other factors and analyze the determinants for the underwriter's allocation decision in a regression model. To test the second empirical implication that is derived from Benveniste and Spindt (1989), it is of particular importance to analyze the influence of the expected profitability of an IPO on the allocations to different investor groups. The dependent variable in the regression model is therefore the normalized rationing for each investor group k. This leads to the following regression setup:

$$NR_k = \alpha + \beta_1 * LNVAL + \beta_2 * FREEFLOAT + \beta_3 * HIGHTECH + \beta_4 * LNS + \beta_5 * CO\text{-}LEAD + \epsilon$$

[30] The latter is due to two issues in which the normalized rationing for retail investors is larger than 3. In both of these issues, retail investor demand less than 10% of the shares and receive more than 20% of the allocation. If these two issues are not considered, the normalized rationing for retail investors is not statistically different from 1 any more.

[31] The significant result here is driven by the same two outliers that are discussed in the previous footnote. Without these outliers, the result is not significantly different from 1 any more.

Table 9a
Normalized rationing for investor groups.

	Overall	Underpricing (UP)		
		L: $UP < 0\%$	M: $0\% \leqslant UP \leqslant 25\%$	H: $UP > 25\%$
Number of issues	41	11	14	16
Institutional				
Mean	1.0164 (0.67)	0.9910 (0.38)	0.9719 (1.05)	1.0726 (3.47)***
Median	0.9953	0.9677	0.9904	1.0547
STD	0.1553	0.1516	0.1711	0.1340
Retail				
Mean	1.1308 (1.44)	1.0315 (0.78)	1.3745 (2.98)***	0.9859 (0.20)
Median	1.0472	1.0472	1.0956	0.7940
STD	0.5812	0.2576	0.8050	0.4583
Dom. inst.				
Mean	1.1671 (4.35)***	1.0546 (1.52)	1.1281 (3.03)***	1.2787 (9.07)***
Median	1.1164	1.0854	1.0958	1.2605
STD	0.2459	0.2299	0.2704	0.1967
For. inst.				
Mean	0.9266 (2.34)*	0.9443 (1.52)	0.8678 (4.20)***	0.9736 (1.16)
Median	0.9060	0.9080	0.8961	0.9472
STD	0.1927	0.2352	0.2015	0.1454

Notes. The table reports the normalized rationing for all investor groups. Normalized rationing is defined as the ratio of percentage allocation to percentage demand at the offer price. Figures are reported for all sample issues and for three groups, in which issues are sorted by their initial return. The t-statistics in parentheses report whether the normalized rationing is equal to one.

* Significance at the 10 percent level.
*** Idem, 1 percent level.

Table 9b
Wilcoxon z-statistics.

	L/M	M/H	L/H
Institutional	0.30	1.78*	1.44
Retail	1.50	1.59	0.33
Domestic institutional	0.73	1.72*	2.64***
Foreign institutional	0.86	1.63	0.37
	L/M	M/H	L/H
	Inst/ret		Dom/for
L	0.45		1.11
M	1.83*		2.91***
H	0.73		4.99***

Notes. The upper table reports Wilcoxon z-statistics for the pair-wise comparison of the normalized rationing for each investor group in issues with low underpricing (L), issues with medium underpricing (M), and issues with high underpricing (H). The null hypothesis is that the normalized rationing for the respective investor group is not different across issues with different levels of underpricing. The lower table reports Wilcoxon z-statistics for the comparison of the normalized rationing for institutional and retail investors as well as domestic and foreign institutional investors for issues with low underpricing (L), issues with medium underpricing (M), and issues with high underpricing (H). The null hypothesis is that the normalized rationing is not different for the respective investor groups for issues with a given level of underpricing.

* Significance at the 10 percent level.
*** Idem, 1 percent level.

The control variables are defined in the same way as in Table 6. *CO-LEAD* is included again to test whether allocation patterns are different in IPOs in which the sample bank is the only lead underwriter and in IPOs in which the sample bank has other co-lead underwriters. This is important in order to analyze whether the allocation patterns are specific to the sample underwriter.

While certain investors are informed about the IPO market value in Benveniste and Spindt (1989), the underwriter has to elicit the information from these informed investors, which is subsequently

Table 10
OLS regression of normalized rationing on subscription and control factors.

	NR institutional		NR dom. institutional		NR for. institutional	
	(1)	(2)	(3)	(4)	(5)	(6)
INTERCEPT	0.768	0.853	0.508	0.636	0.896	1.051
	(3.29)***	(3.33)***	(1.41)	(1.61)	(2.79)***	(3.00)***
LNVAL	−0.010	−0.019	0.008	−0.005	−0.015	−0.032
	(0.66)	(1.01)	(0.36)	(0.18)	(0.69)	(1.20)
FREEFLOAT	0.361	0.378	0.452	0.478	0.154	0.186
	(2.36)**	(2.44)**	(1.92)*	(2.00)*	(0.73)	(0.88)
HIGHTECH	0.138	0.142	0.238	0.243	0.137	0.143
	(2.78)***	(2.82)***	(3.10)***	(3.13)***	(1.99)*	(2.07)**
LNS	0.055	0.055	0.092	0.091	0.023	0.022
	(3.20)***	(3.15)***	(3.47)***	(3.41)***	(0.99)	(0.94)
CO-LEAD		0.045		0.069		0.084
		(0.82)		(0.80)		(1.10)
Adjusted R^2	0.44	0.45	0.45	0.46	0.20	0.22
N	41	41	41	41	41	41

Notes. The dependent variable is the normalized rationing (NR) for different investor groups. NR for the respective investor group is defined as the ratio of the percentage allocation to that investor and the percentage demand by that investor group at the offer price. *LNVAL* is the log of the offer volume, which is the number of offered shares multiplied by the offer price. *FREEFLOAT* is the share of the company that is publicly traded after the IPO. *HIGHTECH* is a dummy variable, which takes the value 1 for high-tech companies and 0 for traditional companies. *LNS* is the log of the level of subscription. *CO-LEAD* is a dummy variable that takes a value of one if the sample underwriter has a co-lead underwriter for the respective IPO and a value of zero otherwise. *t*-statistics (in parentheses) are adjusted for heteroskedasticity and the small sample size by the HC3 variant, as proposed by MacKinnon and White (1985).

* Significance at the 10 percent level.
** Idem, 5 percent level.
*** Idem, 1 percent level.

revealed by their demand. The most reliable signal for the underwriter in deciding to whom to allocate favorables IPOs is thus the subscription level at the end of the bookbuilding period.[32] This is the variable of interest in the following regressions. It is of particular importance to analyze the allocation to domestic institutional investors as this is the group that is shown in Section 5. to help the underwriter in issues with weak demand, consistent with the first empirical implication derived from Benveniste and Spindt (1989). This group is therefore expected to receive the most favorable allocations according to the second empirical implication. The expectation is that the normalized rationing for domestic institutional investors increases in issues with higher subscription levels.

The regression results in the first two columns of Table 10 show that the subscription level significantly and positively affects the relative allocations to institutional investors. They also increase in issues with a higher free-float, i.e. in issues in which the post-IPO monitoring of the management might become more important. Furthermore, allocations to institutional investors are higher in issues of high-tech companies. This suggests that underwriters favor informed investors in particular in issues with higher information asymmetry in which they particularly need to elicit information from these investors. The second column of Table 10 shows that allocations are independent of the presence of a co-lead underwriter in a given IPO. This suggests that the allocation decisions are not specific to the sample underwriter.

To directly test the second empirical implication, relative allocations to domestic and foreign institutional investors are now analyzed separately. The results, which are reported in columns (3) to (6), suggest that the preferential allocations to institutional investors are only due to the favorable treatment of domestic institutional investors. While the log of the subscription level has a positive and

[32] Subscription level and underpricing are highly correlated with a coefficient of 0.78, which is significant at the 1% level.

highly significant impact on the relative allocations to domestic institutional investors, it has no influence on the relative allocations to foreign institutional investors. These results are consistent with the second empirical implication of Benveniste and Spindt (1989). They suggest that only those investors are rewarded with favorable allocations in IPOs that help the underwriter to guarantee the placement success in issue with weak demand. The presence of a co-lead underwriter has no impact on the relative allocation to domestic and institutional investors, as the insignificant coefficients for CO-LEAD in columns (4) and (6) suggest.[33]

6.3. Interpretation of allocation results

The results in the empirical analyses show that institutional investors are indeed better informed than retail investors and can thus serve as a proxy for the group of informed investors whose existence forms the key building block for Rock (1986) and Benveniste and Spindt (1989). Retail investors demand relatively more shares in overpriced issues, while institutional investors are better able to adjust their demand elasticity and quantity across issues with different initial returns.

The analysis of the demand over time and the underwriter's discretion tests the two empirical implications that are derived from Benveniste and Spindt (1989) in Section 3. It suggests that a subset of the informed investors, the domestic institutional investors, are encouraged to buy into issues with weak demand to help the underwriter guarantee the placement success. At the same time, these investors obtain favorable allocations in underpriced issues to compensate them for the losses they bear from their intervention. The results are consistent with the quid pro quo hypothesis in the multi-period model in Benveniste and Spindt (1989), which underlies the two empirical implications in this paper. The quid pro quo can explain why domestic institutional investors receive more favorable allocations than foreign institutional investors even though the latter show a better ability to adjust their demand to the initial return of a new issue.

The question remains whether the results of this paper are valid only for the sample investment bank, are applicable primarily to the European setting, or may represent general patterns. While a general answer to this question is beyond the scope of this paper, some further empirical observations may alleviate the question of sample specificity.

As mentioned above, global co-bookrunners, which represent most of the worldwide leading investment banks, are involved in more than 40% of the issues. The demand and allocation estimations in Tables 6 and 10 explicitly control for the involvement of these co-bookrunners, and the results are robust. The involvement of other investment banks does thus not affect the results. The demand patterns over time as well as the allocation of shares between different investor groups are not different in issues in which the sample underwriter is the only bookrunner and in issues in which there are co-bookrunners.[34]

A different interpretation of the results in this paper could be that domestic investors receive instant rather than repeated-game compensation for stepping in. In particular, the underwriter could promise these institutions a low offer price when observing weak first-half demand and asking them to step in. But, apart from being questionable from a legal perspective, this type of behavior would be hard to reconcile with the empirical evidence. The 12 issues in which demand does not exceed supply after the first half of the bookbuilding period have an average underpricing of −2.06% (median: −0.53%) and investors thus lose money in these issues on average. If instant compensation was indeed the underwriter's interest, the underwriter could choose a lower offer price in 8 of these 12 sample issues, as only 4 sample issues are priced at the lower end of the bookbuilding range.

Another different interpretation of the results refers to the nationality of the underwriter and issuers. As mentioned in Section 2, 35 of the sample issues are brought to the market in the country in which the underwriter is headquartered, and an institutional investor is classified as domestic if

[33] In alternative specifications, the simple subscription level, the squared subscription level, the initial return, and the subscription level at the midpoint of the bookbuilding range are employed as the key explanatory variable. In all cases the results, which are available upon request, are not different from those for the log expression.

[34] While not reported here, the allocation share to institutional investors is very similar for the 35 IPOs in the main sample country and for the 6 IPOs in the other countries.

its headquarters are located in the same country in which the IPO is listed and offered to retail investors. The group of domestic institutional investors is thus widely coherent across the sample issues and can therefore be shown to repeatedly buy into issues with weak demand and be rewarded by better allocations in underpriced issues, which is consistent with the quid pro quo argument.[35] But the domestic institutional investors are not only domestic to the underwriter and thus inclined to help the underwriter, but they are also domestic to most of the issuers and could thus be inclined to help the issuers. While the available data do not allow us to empirically distinguish between these two interpretations, the latter seems to be unlikely as it is unclear how friendly domestic investors could be rewarded by companies for buying into issues with weak demand, which are potentially overpriced. Furthermore, as most of the issuing companies encounter capital markets for the first time at the point of time of their IPO, it is not clear how they would even know enough investors to convince them to buy shares.[36] A remaining possibility would be that domestic investors are pushed politically and not induced by the underwriter to buy into issues in their home country. A press search around the issuing date on the issues with weak demand does not provide any indication for this. It would also be questionable whether any political authority would be willing to use its political credibility as frequently as it would be required in IPOs.

The open question is whether specific institutional settings induce underwriters to behave differently in Europe than in the U.S. On the one hand, the results in previous papers on the allocation of shares between institutional and retail investors, which are the only ones that can be compared to this sample, closely match the sample figures. On the other hand, there are at least four major institutional differences. The effects of these would have to be analyzed before generalizing the results of this paper internationally. First, the underwriter cannot easily revise the offer volume or the price range contingent on investors' demand. This is common practice in the U.S. and may change the investors' bidding strategies. Second, the sample issuers are on average in a later stage of their life cycle than U.S. issuers and may therefore exhibit lower information asymmetries. Third, the existence of a when-issued market in the sample countries helps retail investors to become more informed, as shown by Löffler et al. (2005) and Cornelli et al. (2006). The fact that retail investors are still worse informed than institutional investors in these countries suggests that the winner's curse could be even more pronounced in the U.S. where no when-issued market exists. Finally, universal banks have traditionally played a larger role in Europe than in the U.S. As shown by Puri and Rocholl (2008), the allocation decision by commercial banks may be driven by cross-selling incentives.

7. Robustness tests

Several further tests are performed to check the robustness of the results.

7.1. Informativeness

The paper uses institutional investors as a proxy for informed investors as they are better able than retail investors to adjust their demand behavior to the initial return of an IPO. The implicit assumption in this argument is that the underwriter's pricing decision is known to investors. As argued before, it is crucial to verify whether the results in this paper still hold true when a different classification is chosen that is completely independent of the underwriter's pricing decision. In the sample IPOs, the underwriter is not allowed to set the price outside the bookbuilding range. This means that IPOs for which informed investors know that the true price lies above the bookbuilding range are necessarily underpriced. Equivalently, IPOs for which investors know that the true price is below the bookbuilding range must be overpriced. Only for the IPOs with a true price within the bookbuilding range, informed investors do not know whether these IPO will eventually be over- or underpriced. The sample IPOs are therefore sorted into three groups based on the relation between the first market price of an IPO and the bookbuilding range. Then the analyses in Tables 2, 3 and 5 are repeated

[35] The interpretation of favorable allocations to domestic institutional investors would be different if the issues were widely distributed across different countries and the definition of domestic investors thus changed frequently.

[36] This is in essence why these issuing companies choose an underwriter and the bookbuilding procedure in the first place.

for this classification.[37] The results confirm the key result from the first classification. Institutional investors demand on average 72.25% of the shares in those 22 sample IPOs in which the market price lies above the bookbuilding range, which is significantly more than the 63.49% of the shares that they demand on average in those 15 IPOs in which the market price lies inside the bookbuilding range. As there are only 4 IPOs in which the market price is below the bookbuilding range, no meaningful statistical analysis can be conducted for this group. However, the fact that institutional investors demand 79.66% and domestic institutional investors demand 38.12% of the shares in these issues can be regarded as further suggestive evidence for the quid pro quo in Benveniste and Spindt (1989).

7.2. Demand access

An alternative potential interpretation of the results is that investor groups' demand shares might not be driven by information but rather by the lack of access to certain issues. For example, the underwriter might decide to market those issues that are expected to be underpriced only to certain investor groups. Therefore it is analyzed whether retail, domestic institutional, and foreign institutional investors can submit bids in the same way across the three return groups. The average total number of banks in the syndicate is computed for each return group. The median amounts to four banks for each group; the mean ranges between 4.72 for the overpriced issues and 5.71 for the highly underpriced issues, and the difference is not statistically significant with a p-value of 0.53. Second, the structure of the banks in each syndicate is considered. For each of the banks in the syndicates, a 3×2 matrix is formed with its geographic reach (Country, Europe, International) on the one dimension and its customer reach (Retail, Institutional) on the other. For each of the six market segments in which a bank might be present, the bank is assigned points. It obtains 1 point for full presence and 0 for no presence. 0.5 points are assigned for cases in the middle, e.g. on the retail side banks with only regional focus within one country or private banks without country-wide branches. This means that a bank can obtain a maximum of six points. There is again no statistically significant difference across the return groups. The average number of points per bank according to the matrix varies between 3.31 for the highly underpriced issues and 3.45 for the overpriced issues. It should be clearly pointed out that these tests have only limited power given the small size of the sub-samples, but they suggest that the different sub-samples do not differ substantially from each other.

7.3. Demand over time

Finally, it is important to rule out the possibility that the demand patterns over time are driven by other differences between the issues with weak demand and the issues with strong demand. For this purpose, two more robustness checks are performed. First, the average lengths of the bookbuilding periods are calculated for the two demand groups. The mean for issues with weak demand amounts to 7.67 days (median: 7.5) and for issues with strong demand to 6.83 days (median: 6). The difference is not statistically significant with a z-statistic of 0.8. Second, the average issue sizes in the two groups are analyzed, and there is no difference either. The p-value amounts to 0.45.[38] It should again be pointed out that these tests have only limited power given the small size of the sub-samples, but they suggest that the different sub-samples do not differ substantially from each other.

8. Conclusion

The paper derives two empirical implications from Benveniste and Spindt (1989) and tests these implications for a sample of European IPOs. It provides evidence for the open question in previous research whether favorable allocations to institutional investors are due to differences in demand or allocation.

[37] The results are available upon request.

[38] The figures for demand access and demand over time are also computed for the 35 IPOs in the main sample country and for the 6 IPOs in the other countries. While the small sample size for the latter does not allow a meaningful statistical test, the unreported average figures suggest that the two groups of IPOs are very similar in these two aspects.

The results in the paper suggest the existence of a quid pro quo between the underwriter and some institutional investors, which is consistent with Benveniste and Spindt (1989). These investors guarantee the underwriter the placement success in issues with weak demand and serve as a "friend in need." They are rewarded for their additional demand by favorable allocations in underpriced issues. The fact that issuers are guaranteed a high placement success in IPO bookbuilding helps to answer the question why issuers favor this mechanism at least in this setting. Issuers and their managers and owners may consider the placement success as crucial because of their substantial benefits from going public.

The results for this sample of IPOs also suggest that institutional investors show a better ability than retail investors to detect underpriced issues. Institutional investors use their full decision space by adjusting both their demand elasticity and quantity, whereas retail investors concentrate on the quantity dimension. The paper shows that the underwriter treats demand by institutional and retail investors not differently on average.

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