

# **Who Knows What When? - The Information Content of Pre-IPO Market Prices**

**Gunter Löffler<sup>a</sup> / Patrick F. Panther<sup>b</sup> / Erik Theissen<sup>c</sup>**

February 2001

preliminary version - please do not quote

---

<sup>a</sup> University of Frankfurt/Main, Lehrstuhl für Bankbetriebslehre, Mertonstr. 17-21, 60054 Frankfurt, Germany.  
<sup>b</sup> University of Frankfurt/Main, Lehrstuhl für Kreditwirtschaft und Finanzierung, Mertonstr. 17-21, 60054 Frankfurt, Germany.  
<sup>c</sup> University of Bonn, BWL 1, Adenauerallee 24-42, 53113 Bonn, Germany.

# **Who Knows What When? -**

## **The Information Content of Pre-IPO Market Prices**

### **Abstract**

To resolve the IPO underpricing puzzle it is essential to analyze who knows what when. In Germany, broker-dealers make a market in IPOs during the subscription period. We examine these pre-issue prices and find that they are highly informative. They are closer to the first price that is subsequently established on the exchange than either the midpoint of the book-building range or the offer price. We further document that pre-issue prices are unbiased estimates of the subsequent first exchange price. They explain a large part of the underpricing which can not be explained by other variables. The results imply that information asymmetries are much lower than the observed variance of underpricing suggests, a finding which is relevant for judging the validity of underpricing theories.

JEL classification: G10, G14, G24

## **Introduction**

The underpricing of initial public offerings has been the subject of intensive theoretical and empirical research and yet still represents a puzzle. At the heart of the puzzle is the question of who knows what, and when. Do informed investors know more about the firm value than the issuer and the underwriter (as is assumed by, e.g., Rock 1986, Benveniste / Spindt 1989)? Does the underwriter know more than the issuer (as in the principal agent models of Baron / Holmström 1980, Baron 1982)? Or does the issuer know the firm value but voluntarily chooses to underprice (as is assumed in the signaling models of Allen / Faulhaber 1989, Grinblatt / Hwang 1989, Welch 1989 or in the optimal ownership structure models of Brennan / Franks 1997 and Stoughton / Zechner 1998)?

Finding an answer to these questions is complicated by the fact that there is usually no price history before an IPO. In Germany, by contrast, there is an active market for pre-issue trades in initial public offerings. In compliance with German financial regulation, broker-dealers offer OTC pre-issue trading for investors who want to buy or sell shares during the book-building period. The price range is not bounded by the bookbuilding spread or any other limits. The pre-IPO prices represent an ideal opportunity for analyzing the quality of the information on firm value which is available during the IPO process.

The information revealed through pre-IPO trades is potentially relevant for underwriters, investors and issuers. Underwriters learn about the market's assessment of the firm value and can set the final offer price accordingly. Investors can use the information contained in the pre-IPO prices to discriminate between overpriced and underpriced issues. To the extent that the prices are indeed informative, uninformed investors can make their subscription decision contingent on the pre-IPO prices and thereby alleviate or even eliminate the winner's curse problem. Therefore, the winner's curse problem addressed by Rock (1986) and others may not be a valid explanation of the underpricing phenomenon in the presence of an efficient pre-IPO market. Issuers, finally, are provided with a benchmark for the pricing proposal of their investment bank. This is of importance as investment banks may intentionally underprice stocks to reap the benefits of lower marketing costs or of high commissions paid by investors who seek preferential allocations of shares.<sup>1</sup>

---

<sup>1</sup> Cf. Baron / Holmström (1980), Baron (1982) and Loughran/ Ritter (2000)

In the present paper we use pre-issue trading prices for more than 300 German IPOs to investigate what is known about the firm's value during the bookbuilding period. Specifically, we test whether pre-issue trading prices are unbiased estimates of the post-issue prices determined on the first day of exchange trading. We further analyze whether the pricing errors (defined as the percentage difference between pre-issue and post-issue prices) are related to the determinants of the magnitude of underpricing that have been uncovered in previous empirical research.

We do not have knowledge of prior academic research on pre-IPO trading. Apparently, in most countries pre-IPO trading is illegal.<sup>2</sup> However, regulators are aware of the issue. An expert group at FESCO, the Paris-based Forum of European Securities Commissions, deals (among other IPO-related subjects) with these pre-IPO "grey" markets.

Our work is related to previous research analyzing the price formation for newly listed issues. Barry / Jennings (1992) and Schultz / Zaman (1994) report that the initial return is almost entirely reflected in the opening price on the first trading day. Aggarwal / Conroy (2000) analyze the quoting activity before the opening price on the first day of exchange trading is set and find that learning takes place in the pre-opening period. The present paper extends this line of research by analyzing prices set during the entire bookbuilding period (rather than only in the pre-trading period on the first day of exchange trading).

Our results can be summarized as follows. The pre-IPO prices are highly informative. They are closer to the price subsequently established on the exchange than either the midpoint of the bookbuilding range or the offer price. Further, the IPO prices appear to be unbiased estimates of the subsequent exchange prices. Finally, the pre-IPO return (defined as the "return" between the midpoint of the bookbuilding spread and the midpoint of the IPO quotes on the day prior to the first exchange listing) explains a large part of the underpricing left unexplained by other variables like issue size and market momentum.

The remainder of the paper is organized as follows. Section I is an overview of the German market for pre-issue trading. In section II we present our data set and some descriptive statistics. Section III analyzes the accuracy of the pre-IPO prices and their relation to underpricing. In Section IV we summarize our findings and discuss their implications.

---

<sup>2</sup> This does not necessarily mean that pre-IPO trades, at least among banks, do not take place. A report in the Economic Times (February 8, 2000) reports on large activities in the informal grey market for IPOs in India.

## I. Institutional Aspects of Pre-IPO Trading

In Germany, special venues for trading new share issues before their first listing and, most importantly, during the subscription period, exist since the early 80s. This market segment is called *Handel per Erscheinen* and is also known as one segment of the „Grey Capital Market“. In the present paper we interchangeably use the terms *pre-IPO trading* and *pre-issue trading*.

This market segment has, for a long time, been rather small and restricted to banks and has not received much attention. However, since 1997 the number of IPOs has reached unprecedented levels. Several large and well-marketed issues (like Deutsche Telekom AG and Infineon Technologies AG) and the success of the new market segment for growth companies (*Neuer Markt*) have contributed to this IPO wave. Private investors have become increasingly involved in the IPO market even though, as a consequence of high oversubscription rates, the odds of being allocated shares were not in favor of the average investor. This experience has brought the pre-IPO market to the attention of many investors. New trading platforms and the internet have also led to wider information dissipation and more price transparency. Bid and ask quotes are disseminated via the large information vendors (REUTERS, Bloomberg) and the Internet.<sup>3</sup> Daily newspapers (e.g. FAZ and Börsenzeitung) often report these prices when reporting about ongoing IPOs. In addition, the Börsenzeitung publishes summary post-trade information each day (daily high and low prices, trading volume and 4 p.m. quotes).<sup>4</sup> We now describe the institutional aspects of the pre-IPO market in more detail.

### Trading „as if and when issued“

The trades in the pre-IPO market can be characterized as forward trades in shares that are in the process of going public. The transactions are contingent on the announced IPO taking place („if issued“) and are settled on the first trading day of the stock in the secondary market („when issued“). In case the IPO is cancelled the pre-issue trades are reversed. If the subscription period is extended by more than three days or if the bookbuilding price range is changed, all orders that have not yet been filled are cancelled. Otherwise all submitted orders are bind-

---

<sup>3</sup> On the Internet this information is freely available on the websites of the broker-dealers themselves, the sites of the large online-brokers and on many IPO-forums including prominent sites like yahoo.de. Recently mobile communication devices like WAP mobile phones have been added to these information and ordering channels. In 2001 L&S has started a new trading platform in cooperation with a regional stock exchange (Düsseldorf) and an information vendor (VWD).

<sup>4</sup> Volume information is only available since June 2000 and only for trades with Schnigge. However, Schnigge claims to have an 80% market share (annual report 1999, p.14).

ing. Note that, contrary to other countries, a change of the bookbuilding range is very uncommon in Germany. Until recently all IPOs sold through the bookbuilding method had a binding upper bookbuilding price. Only recently did some offering prospecti allow for upward-adjustments of the bookbuilding range in response to changing overall market or specific demand conditions.

### Market organization

Several broker-dealers organize competing markets in pre-issue trading. They are supervised by the Bundesaufsichtsamt für den Wertpapierhandel. Until 1998 the pre-IPO market was a classical OTC market. Trading took place only via telephone, mainly between banks. Later, the quotes were made available to retail investors on the internet and through other information channels. Since summer 2000 the leading market participants have started – some in cooperation with large online-brokers - to implement online trading platforms, which give all investors fast and simple access to market information and order submission.<sup>5</sup>

The two market leaders are the broker-dealers Börsenmakler Schnigge AG and Lang & Schwarz Wertpapierhandel AG (L&S).<sup>6</sup> They restrict market making to issues sold through the bookbuilding procedure, which is the dominant method in Germany since the mid 1990s. Pre-IPO trading usually starts when the bookbuilding range and the exact timing of the issue (i.e., the subscription period and the day of the first exchange listing) are published. First quotes are set after communication with market participants. Subsequently, quotes are adjusted in response to new information and demand and supply conditions. Pre-issue trading takes place from 8 a.m. to 11 p.m. The last trading day is the day before the first listing on the exchange.

Pre-IPO trading covers most issues that are subsequently listed on the first segment of the stock exchange (amtlicher Handel) or on the Neuer Markt. Brokers do not make a market in issues for which they or one of their cooperating partners act as underwriters. As an explanation for this abstinence, they mention potential conflicts of interest. Therefore, if our analysis reveals that the pre-IPO prices are informative, this is *not* because the underwriter is the market maker.

---

<sup>5</sup> Schnigge (the market leader) trades only with members of an exchange. Private investors must address their bank or can use the new trading platforms, which provides indirect, but essentially real-time, access to stock trading.

<sup>6</sup> Both are themselves listed companies and mention pre-IPO trading as being their most important business in terms of volume and profitability. Schnigge reports 5 million monthly page impressions on their web sites.

### Market Participants and Trading Motives

Investors placing orders with the bookrunner may gain from underpricing when they are allocated shares. However, high oversubscription rates make this a rare event, especially when the issue is small. The pre-IPO market offers the opportunity to buy shares without bearing allocation uncertainty. This is one motive for buyers.

Institutional investors, on the other hand, often receive preferential allocations. If they are confident to get allocated shares in the IPO, they may sell these shares in the pre-IPO market in order to lock in profits. Similarly, investors who already own shares can sell them in the pre-IPO market as long as these shares are not subject to lockup restrictions. Finally, informed investors (and investors who believe that they are informed) may trade in the pre-IPO market in order to exploit their informational advantage.

## **II. Data**

In our analysis we use quote and transaction data from the broker Börsenmakler Schnigge AG. This brokerage firm is the leading market maker for pre-issue trading. Our raw data is from two different sources. First, Schnigge maintains a historical data base which contains the last bid and ask quotes from the day before the IPO (i.e., the day before the stock is first traded on the exchange). From this data base we collected all quotes in the period from 06/30/98 to 02/14/01. We refer to the resulting sample as the *full sample*. It covers 355 firms. Second, the actual bid and ask quotations throughout the trading day are available on the website of Börsenmakler Schnigge AG. We collected this intraday data from 07/27/00 onwards at hourly intervals. We take the quotes recorded at 4 p.m. to construct a sample with daily quotes. We refer to this sample as the *daily sample*. The more detailed hourly data is used for illustrative purposes only.

We restrict the analysis to trades in stocks that went public on the Frankfurt Stock Exchange. We obtained data on these IPOs (offer price, IPO volume, bookbuilding spread, first trading price, market segment) from the exchange. Out of the 389 stocks which went public on the Frankfurt Stock Exchange from 06/30/98 to 02/14/01, Schnigge made a pre-IPO market in

342 issues.<sup>7</sup> 295 of these companies chose to list on the Neuer Markt, the growth segment of the Frankfurt Stock Exchange. Table I presents descriptive statistics for these offerings and the quotes from the last day before the IPO.

Insert Table 1 about here

The average size of an issue is € 119 million, the median is € 41.6 million. The distribution of the issue size is, as is evidenced by the discrepancy between the median and the mean, heavily skewed. The underpricing in the sample period was substantial. The average underpricing was 44.7%, the median was 15.6%. Less than 10% of the issues were *overpriced*.

As discussed in section I, the pre-IPO market is a market maker market. The quoted bid-ask spreads are, as documented in Table 1, rather wide, averaging 10.5%. However, given the uncertainty about the true value of the stock and the potentially high degree of informational asymmetry in IPOs, there may be good economic reasons for these wide spreads. To check whether the determination of the bid-ask spread conforms to this economic reasoning, we regressed the spread on proxies for this information uncertainty: the log of the IPO volume, the inverse of the midpoint of the bookbuilding range and the width of the bookbuilding range (defined as the difference between the maximum and the minimum of the range, divided by its midpoint). The results are as follows ( $n = 339$ ,  $R^2 = 0.18$ , t-statistics in parentheses):

$$s_i = 10.87 - 0.712 \ln(\text{Vol}_i) + 37.08(1/\text{BB-Midpoint}) + 0.015\text{BB-Range}$$

$$(9.73) \quad (3.24) \quad (5.79) \quad (0.36)$$

In line with accepted theories of the bid-ask spread, the spreads are wider for smaller firms and are inversely related to the price level. The width of the bookbuilding range does not have explanatory power.

Price discovery should be associated with changing bid and ask quotes. We use the hourly data to analyze the frequency of quote changes. In 43.4% of all recorded cases, either the bid or the ask price or both changed from one hour to the next.<sup>8</sup> The quotation activity thus is sufficient for a meaningful analysis of price discovery during pre-issue trading.

Insert Figure 1 about here

---

<sup>7</sup> As noted above, Schnigge does not make a market if the IPO is sold other than through bookbuilding, or if Schnigge is involved in the underwriting.

<sup>8</sup> In no case were these changes associated with changes in the bookbuilding spread.



Figure 1 presents an example. The figure shows the evolution of the pre-IPO quotes for Linos AG, a company which went public on the Neuer Markt on September 1, 2000. The offer range was € 24 to € 27, the subscription period lasted from August 24 to August 30. Pre-IPO trading began on August 23 (day of the announcement of the offer range) and lasted until August 31 (day before first trading on the exchange). The first pre-IPO bid prices were more than 30% above the upper end of the offer range. In the course of the offering, the quotes rose steadily to more than € 50 shortly before the IPO. The daily average trading volume, which we collect from the newspaper *Börsenzeitung*, was 9,450 shares. This is equivalent to 0.68% of the issue volume. The offer price of € 27 was set at the upper end of the bookbuilding range. The first market price on September 1 was € 73. In this particular case, the pre-IPO quotes were thus considerably lower than the first market price, but they were also consistently closer to it than either the midpoint of the bookbuilding range or the offer price. In addition, the difference between the pre-IPO quotes and the subsequent first market price decreased in the course of the pre-issue trading period. This is evidence of price discovery and information aggregation through pre-issue trading. The next section will reveal whether this picture is representative.

### III. Empirical Results

We present our empirical results in two subsections. In the first we look at the accuracy of the prices set in the pre-issue trading period and the contribution of pre-issue trading to the price discovery process. In the second subsection we analyze the determinants of IPO underpricing, taking into account the information incorporated in the pre-issue prices.

#### III.1. Pricing Accuracy

A first indication of the accuracy of the pre-IPO prices is the frequency with which the subsequent first market price on the exchange falls within the last pre-IPO quotes. We find this to be the case for 53.8% of the IPOs in our sample. In contrast, only 24.0% of the first exchange prices are inside the bookbuilding range.<sup>9</sup>

To assess the accuracy of the pre-IPO quotes in more detail we examine the percentage difference between the first market price and the prices set during pre-IPO trading. We define the pricing error as:

---

<sup>9</sup> In 86.9% of the cases the percentage bookbuilding range is *wider* than the last pre-IPO spread. The results reported in the text are thus not driven by excessively wide spreads.

$$\text{Pricing error} = (1^{\text{st}} \text{ market price} / \text{pre-IPO price}) - 1$$

We take the pre-IPO prices to be the average of the quoted bid and the quoted ask price. Pre-IPO prices are calculated for different points in time. Specifically, we calculate variants of the pricing error based upon prices quoted on the last day before the subscription period, on the first and last day of the subscription period, halfway through the subscription period, and on the day before trading on the exchange starts.<sup>10</sup> In order to gauge the magnitude of the pricing error we use the pricing errors defined relative to, first, the midpoint of the bookbuilding range and, second, the offer price as benchmarks.

Insert Table 2 about here

Table 2 presents descriptive statistics on the pricing errors. The results for the full sample are shown in Panel A. The mean pricing errors are 51.7% for the midpoint of the bookbuilding range and 44.7% for the offer price. This indicates that the first price set on the exchange on the first trading day is approximately 50% larger than the midpoint of the bookbuilding range and the offer price. In sharp contrast, the last pre-IPO price is, on average, almost equal to the first price on the exchange. The average pricing error is only 0.8% and is not significantly different from zero (t-value 0.92, z-value for a Wilcoxon test 1.33). In addition, the root mean squared errors show that the dispersion of pricing errors is lower for pre-IPO quotes than for either the midpoint of the bookbuilding range or the offer price. The same relation holds for the standard deviation of the pricing errors. This implies that the pre-IPO prices are not only less biased, but also more efficient estimates of the true price than either the midpoint of the bookbuilding range or the offer price.

The differences in pricing accuracy are statistically significant. We conducted t-tests as well as non-parametric Wilcoxon tests of the null hypothesis of no difference between pricing errors of pre-IPO quotes on the one hand and those of offer range midpoint and the offer price on the other hand. In each of the tests, which we performed for both absolute and squared pricing errors, the null-hypothesis is rejected at the one percent level or better.

---

<sup>10</sup> Note that pre-issue trading before the first day of the subscription period did not take place for all stocks. Consequently, pre-IPO prices for the last day prior to the subscription period are not available for some stocks. Further, in some cases exchange trading started one day after the last day of the subscription period. In these cases the pre-issue price on the last day of the subscription period and on the day before trading on the exchange starts are identical.

These results indicate that, first, the pre-IPO prices are significantly more informative than the bookbuilding range and the offer price and, second, that the pre-IPO prices are good proxies for the first market prices set on the exchange on the first trading day.

Moving on to the daily sample, a similar picture emerges. The last pre-IPO quotes are, again, more accurate than the offer price. The relation of the quotes' RMSE to the offer prices' RMSE is 0.248, which is of the same order of magnitude as the corresponding value of 0.18 for the full sample. This supports the view that the daily sample is representative even though the general market conditions were different. (The mean underpricing was 44.7% in the full sample but fell to 21.3% in the daily sample.) Quotes set on the day before the start of the subscription period are already more accurate than the offer range midpoint or the offer price. During the bookbuilding period, the pricing accuracy steadily increases. This implies that the quality of the information available to market participants rises over time. The differences are statistically significant in most cases. Most importantly, the quotes from the day before the start of the bookbuilding are found to be more accurate than both the offer range midpoint and the offer price (significance level of 5% or better using a t-test or a Wilcoxon test).

If pre-IPO prices rationally incorporate available information they should be unbiased estimators of the true value of the stock. This can be tested by running the following regression:

$$P_i = \alpha_j + \beta_j p_{i,j} + \varepsilon_{i,j}$$

$P_i$  is the "true" price and  $p_{i,j}$  is an estimate of the true price. Unbiasedness implies  $\alpha_j = 0$  and  $\beta_j = 1$ . We take the first price set on the exchange to be a valid proxy for the true price.<sup>11</sup>

In our alternative regressions,  $p_{i,j}$  is taken to be

- the midpoint of the bookbuilding range
- the offer price
- the pre-IPO price.

Given the descriptive statistics discussed above we expect only the pre-IPO price to be an unbiased estimator of the true price.

Insert Table 3 about here

---

<sup>11</sup> See, among others, Rock (1986) for a justification of this assumption.

The results are shown in Table 3. The results for the full sample, presented in Panel A, are fully consistent with our prior expectations. The pre-IPO prices are unbiased estimators of the true price (i.e., the joint null hypothesis  $\alpha_j = 0$  and  $\beta_j = 1$  is not rejected) whereas the midpoint of the bookbuilding range and the offer price are not. In addition, the high  $R^2$  of 0.967 also suggests that the pre-IPO prices are precise estimators of the true price.

The results for the daily sample are shown in Panel B of Table 3. The  $R^2$  in the regressions based on pre-IPO prices are unanimously higher than those of the regressions based on the bookbuilding range and the offer price. Further, the  $R^2$  increases as the delay between the pre-IPO price and the day of the first exchange listing decreases. The null hypothesis of unbiasedness is rejected on the 5% level until (and including) the midst of the subscription period. Thus, only pre-IPO prices in the second half of the subscription period appear to be unbiased estimates of the true price. It should be noted, however, that these regressions are based on only 42 observations and a relatively short sample period of seven months.

### **III.2. Pre-IPO Trading and Underpricing**

If the pre-IPO prices are informative, as suggested by the preceding analysis, they should also help to explain the magnitude of the underpricing. To test whether this is the case we proceed as follows. We first identify variables that are, based on previous empirical research (e.g., Wasserfallen / Wittleder 1994, Ljungqvist 1997), considered to have explanatory power for the magnitude of the underpricing. We use the following variables:

- the natural logarithm of the issue volume
- the bookbuilding range, expressed as a percentage of its midpoint
- the return of an appropriate stock index in the 60 days prior to the IPO. This variable is included because a strong positive relation between the underpricing and the market return prior to the issue has been documented for Germany by Ljungqvist (1997). For firms that went public on the Neuer Markt we use the NEMAX Allshare index, for firms listed in the “Amtlicher Handel” we use the CDAX index.

The results of the cross-sectional regression (based on the full sample) are shown in Table 4. The independent variables explain 25% of the variation in the underpricing. The underpricing appears to be lower for larger issues, and we confirm the result that the first day returns are strongly positively related to the index return prior to the IPO. The bookbuilding range, which

serves as a proxy for the ex-ante uncertainty about the true stock value, is significant at the 5% level but does not have the expected positive sign.

Insert Table 4 about here

In the second step we added the pre-IPO return as an additional explanatory variable. It is defined as

$$\frac{\text{Midpoint of pre-IPO quotes}}{\text{Midpoint of Bookbuilding range}} - 1.$$

The pre-IPO quotes are from the last day before the first exchange listing. Inclusion of the pre-IPO return changes the regression results dramatically. The  $R^2$  jumps from 0.25 to 0.80. The bookbuilding range and the index return do no longer have explanatory power for the underpricing. Only the IPO volume retains its significance. Including *only* the pre-IPO return on the right-hand side yields an  $R^2$  of 0.79. The pre-IPO return, therefore, appears to explain a large part of the magnitude of the underpricing.

A different, though related, question is whether those variables that are usually found to explain the underpricing do also have explanatory power for the pre-IPO pricing error. This pricing error is defined as

$$\frac{\text{First exchange price}}{\text{Midpoint of pre-IPO quotes}} - 1.$$

In an efficient market we should not expect to find observable variables that explain the pricing error. The results, also shown in Table 4, reveal, however, that the issue volume has some explanatory power. The coefficient, although only significant at the 10% level, indicates that the pre-IPO quotes tend to be too low for small firms.<sup>12</sup> The other explanatory variables are insignificant. In a final step we analyze whether the absolute pre-IPO return is explained by the same set of independent variables. The only variable that enters the regression significantly is the index return prior to the IPO. It thus appears that pre-IPO prices display a higher pricing error in bull markets. This confirms the view that in a euphoric market, investor interest is expected but hard to predict (cf. Derrien / Womack, 2000).

---

<sup>12</sup> Note that this does not necessarily entail a violation of market efficiency because of substantial transaction cost (the average spread is, as is shown in Table 1, 10.5%).

#### **IV. Summary and conclusions**

In the present paper we exploit a unique feature of the German capital market, namely, the existence of an active market for pre-issue trades in IPOs. This allows us to observe market prices for IPOs already during the subscription period. The information impounded in these prices is potentially relevant for underwriters, issuers and investors. Both the underwriter and the issuer can make use of that knowledge when negotiating the offer price. Private investors can use the information in the pre-IPO prices to discriminate between overpriced and underpriced issues, thereby avoiding to subscribe to overpriced issues.

Our analysis yields the conclusion that the pre-IPO prices are indeed highly informative. They are, on average, very close to the price subsequently established on the exchange, much closer than either the midpoint of the bookbuilding range or the offer price. Since the final pre-IPO prices are unbiased estimates of the subsequent exchange prices, there is no indication that they are affected by investor irrationality or price manipulation. Finally, the pre-IPO return (defined as the “return” between the midpoint of the bookbuilding spread and the midpoint of the IPO quotes on the day prior to the first exchange listing) explains a large part of the underpricing which is left unexplained by market momentum and other observable variables.

The results imply that information asymmetries and valuation uncertainty are much lower than the observed variance of underpricing suggests. This has several implications. The informational disadvantage of uninformed investors is largely reduced because they can observe the pre-IPO prices and condition their subscription decision on that information. They can thereby alleviate or even eliminate the winner’s curse problem. Therefore, the winner’s curse problem addressed by Rock (1986) and others does not appear to be a valid explanation for the underpricing phenomenon in Germany. The signaling explanation for underpricing, on the other hand, is consistent with the evidence. In a separating equilibrium, investors infer the firm value from the issuer’s behavior. Thus, one should expect pre-IPO prices to be good predictors of the first market prices. In information acquisition models (Benveniste / Spindt, 1992), underpricing rewards investors for revealing their information during the bookbuilding process. Such information production could, together with information leakages, explain the finding that pricing errors of pre-IPO quotes decrease in the course of the bookbuilding. However, if the goal of the bookbuilding is to elicit as much information as possible and, subject to incentive constraints, incorporate it into the offer price, one should expect offer prices to be more accurate than the first quotes from the day before the bookbuilding. As the empirical evidence suggests otherwise, it appears that either the value of information produced through

the bookbuilding is limited, or investment banks are inflexible in responding to this information.

This leads us to another set of implications pertaining to the design of the selling procedure. For the French market, Derrien and Womack (2000) conclude that bookbuilding is relatively inefficient in controlling underpricing in hot and cold markets. Our evidence suggests that underwriters also neglect firm-specific information which is publicly available before and during the bookbuilding period. There are several ways in which the bookbuilding procedure could be adapted in order to make better use of available information. The bookbuilding range could be set based on observed pre-IPO prices, and changes of the range could be made in response to the development of these prices. In addition, underwriters could increase the width of the range to increase pricing flexibility. Practitioners sometimes argue that a narrow offer range is necessary to prevent winner's curse type of problems.<sup>13</sup> As shown in this paper, however, pre-IPO trading can drastically reduce investor uncertainty so that this argument is not valid.

These suggestions presuppose the existence of an efficient market for pre-IPO trading. The German example shows that such a market is feasible. Of course, if the pre-IPO market were to influence the setting of the offer price more directly, the incentive to manipulate prices would be increased. However, even in the present form in which pre-IPO trading is not directly linked to the selling and underwriting process, the advantages which a pre-IPO market entails for investors, issuers and underwriters appear to be substantial.

---

<sup>13</sup> The argument is as follows. Private investors (who are supposed to be uninformed) usually submit unlimited orders. They thus run the risk of being allocated shares at a price equaling the upper bound of the bookbuilding range even if that price is above the "true" price. If the bookbuilding spread is wide, this risk is aggravated.

## References

- Aggarwal, R. and P. Conroy (2000): Price Discovery in Initial Public Offerings and the Role of the Lead Underwriter. *Journal of Finance* 55, 2903-2922.
- Allen, F. and G. R. Faulhaber (1989): Signalling by Underpricing in the IPO Market. *Journal of Financial Economics* 23, 303-323.
- Baron, D. P. (1982): A Model of the Demand for Investment Banking Advising and Distribution Services for New Issues. *Journal of Finance* 37, 955-976.
- Baron, D. P. and B. Holmström (1980): The Investment Banking Contract for New Issues und Asymmetric Information: Delegation and the Incentive Problem. *Journal of Finance* 35, 1115-1138.
- Barry, C. B. and R. H. Jennings (1992): The Opening Price Performance of Initial Public Offerings of Common Stock. *Financial Management* 22, 54-63.
- Benveniste, L. M. and P. A. Spindt (1989): How Investment Bankers Determine the Offer Price and Allocation of New Issues. *Journal of Financial Economics* 24, 343-361.
- Biais, B. and A. M. Faugeron-Crouzet (1999): IPO Auctions. Working Paper, Université de Toulouse, March.
- Brennan, M. J. and J. Franks (1997): Underpricing, Ownership and Control in Initial Public Offerings of Equity Securities in the UK. *Journal of Financial Economics* 45, 391-413.
- Derrien, F. and K. Womack (2000): Auction vs. Bookbuilding and the Control of Underpricing in Hot IPO Markets. Working paper.
- Grinblatt, M. and C. Y. Hwang (1989): Signalling and the Pricing of New Issues. *Journal of Finance* 44, 393-420.
- Ljungqvist, A. (1997): Pricing Initial Public Offerings: Further Evidence from Germany. *European Economic Review* 41, 1309-1320.
- Loughran, T. and J. Ritter (2000): Why Don't Issuers Get Upset About Leaving Money on the Table in IPOs. *Review of Financial Studies*, forthcoming.
- Rock, K. (1986): Why New Issues Are Underpriced. *Journal of Financial Economics* 15, 187-212.
- Schultz, P. H. and M. A. Zaman (1994): Aftermarket Support and Underpricing of Initial Public Offerings. *Journal of Financial Economics* 35, 199-219.



Stoughton, N. M. and J. Zechner (1998): IPO Mechanisms, Monitoring, and Ownership Structure. *Journal of Financial Economics* 49, 45-77.

Wasserfallen, W. and Ch. Wittleder (1994): Pricing Initial Public Offerings: Evidence from Germany. *European Economic Review* 38, 1505-1517.

Welch, I. (1989): Sequential Sales, Learning, and Cascades. *Journal of Finance* 47, 695-732.

**Table 1: Descriptive Statistics for the Full Sample (339 IPOs from 06/30/98 to 02/14/01)**

The width of the bookbuilding range is defined as  $(\text{upper end} - \text{lower end}) / (\text{upper end} + \text{lower end})$ . Similarly, the width of the pre-IPO quotes is defined as  $(\text{ask} - \text{bid}) / (\text{ask} + \text{bid})$ .

	Mean	Median	Standard deviation
IPO volume (million €)	119.00	41.59	475.64
Underpricing	44.74%	15.63%	69.7%
Width of bookbuilding range	17.53%	16.67%	5.50%
Width of last pre-IPO spread	10.47%	10.00%	4.19%

**Table 2: Analysis of Pricing Errors**

The pricing error is the percentage difference between the first trading price  $P_i$  and a pre-IPO price  $p_{i,j}$ . The root mean-square error is defined as

$$RMSE_{i,j} = \sqrt{\frac{1}{N} \sum_{i=1}^N (P_i / p_{i,j})}$$

For the quotes of the last day before the subscription period the number of observations is reduced to 29 as trading did not commence at this stage in some cases. For these 29 IPOs, the RMSE of the offer range midpoint and the offer price is 59.5% and 50.7%, respectively.

<i>Pre-IPO price</i>	Pricing errors				
	Mean	RMSE	St. Dev	25% Quantile	75% Quantile
<i>Panel A: Full Sample (NOB=343)</i>					
Midpoint of offer range	51.7%	93.6%	0.782	2.6%	74.3%
Offer price	44.7%	82.8%	0.698	1.6%	62.5%
Last pre-IPO quotes	0.8%	15.0%	0.160	-6.7%	4.8%
<i>Panel B: Daily Sample (NOB=41)</i>					
Midpoint of offer range	18.0%	57.1%	54.9%	-16.5%	22.0%
Offer price	21.3%	48.0%	43.6%	0.0%	17.5%
Pre-IPO quotes					
Last day before subscription period	-11.8%	30.1%	28.2%	-32.9%	-1.3%
First day of subscription period	-16.1%	26.9%	21.8%	-30.6%	-5.3%
Mid of subscription period	-12.1%	23.0%	19.7%	-25.0%	-0.9%
Last day of subscription period	-5.6%	15.2%	14.3%	-13.7%	0.0%
Last quotes before	-0.6%	11.9%	12.0%	-6.3%	4.2%

**Table 3: Unbiasedness**

The Table shows the results of the regression

$$P_i = \alpha_j + \beta_j p_{i,j} + \varepsilon_{i,j}$$

where  $P_i$  is the first price set on the exchange and  $p_{i,j}$ ;  $j \in 1, 2, 3$  are price indications that were available prior to the exchange listing. We use, first, the midpoint of the bookbuilding range, second, the offer price, and, third, the pre-IPO prices.

t-statistics (in parentheses) are calculated using heteroscedasticity-consistent standard errors whenever a White tests rejected the null hypothesis of homoskedasticity. The last column shows the p-value for a test of the unbiasedness of the  $p_{i,j}$ , i.e., a Wald test of the joint null hypothesis  $\alpha_j = 0; \beta_j = 1$ .

In Panel B one observation (the IPO of Deutsche Börse AG) has been excluded. The prices were much larger than those of the other IPOs (offer price € 335 and first price on the exchange € 362, compared to € 54 and € 73 for the IPO with the second highest price.

	$\alpha_j$	$\beta_j$	$R^2$	p-value for $H_0$ : $\alpha_j = 0; \beta_j = 1$
<i>Panel A: Full Sample (NOB=343)</i>				
midpoint of bookbuilding range	-1.343 (0.25)	1.674 (7.29)	0.662	0.000
offer price	-1.023 (0.19)	1.587 (7.16)	0.679	0.000
last pre-IPO price	-0.797 (1.05)	1.035 (43.38)	0.967	0.288
<i>Panel B: Daily Sample (NOB=41)</i>				
midpoint of bookbuilding range	0.742 (0.23)	1.175 (7.23)	0.573	0.07
offer price	-0.117 (0.06)	1.271 (7.47)	0.679	0.02
pre-IPO price				
last day before subscription period	-2.535 (0.65)	1.066 (3.75)	0.681	0.11
First day of subscription period	0.462 (0.40)	0.823 (9.73)	0.786	0.01
Midst of subscription period	-0.505 (0.34)	0.917 (8.95)	0.831	0.01
Last day of subscription period	0.396 (0.29)	0.971 (9.78)	0.897	0.07
Last pre-IPO price	-0.333 (0.26)	1.023 (10.27)	0.914	0.96

**Table 4: Pre-IPO trading and underpricing**

The Table shows the results of regressions of a measure of underpricing and the pricing errors in the pre-IPO trading on variables that, based on previous research, are considered to have explanatory power for the magnitude of the underpricing.

Explanatory variables are the natural logarithm of the issue volume, the bookbuilding range (expressed as a percentage of its midpoint) and the return on an appropriate stock index in the 60 days prior to the IPO.

Underpricing is defined as the percentage difference between the first price on the exchange and the offer price. The pre-IPO return is the percentage difference between the midpoint of the pre-IPO quotes on the day before the first exchange listing and the midpoint of the bookbuilding range.

T-statistics (in parentheses) are calculated using heteroscedasticity-consistent standard errors whenever a White tests rejected the null hypothesis of homoskedasticity. The analysis is conducted for the full sample.

Dependent variable	constant	log(volume)	percentage bookbuilding range	index return prior to IPO	pre-IPO return	adj. R <sup>2</sup>
underpricing	0.801 (5.20)	-0.048 (1.82)	-0.013 (2.56)	1.330 (8.00)		0.25
underpricing	0.204 (2.57)	-0.034 (2.54)	-0.004 (1.39)	-0.080 (0.78)	0.902 (15.55)	0.80
underpricing	0.005 (0.28)				0.884 (18.50)	0.79
Pre-IPO return	0.100 (2.24)	-0.0154 (1.77)	-0.002 (1.11)	0.003 (0.08)		0.004
Abs(Pre-IPO return)	0.138 (3.98)	-0.002 (0.40)	-0.002 (1.39)	0.071 (2.66)		0.02

**Figure 1: Pre-issue trading of LINOS AG**

Linus AG went public on September 1, 2000 at an offer price of € 27. The first price established on the exchange was € 73. The offer range was 24 to 27, the subscription period lasted from August 24 to August 30. Pre-IPO trading began on the day of the announcement of the offer range (23 August) and lasted until August 31. The shown pre-IPO bid and ask prices were recorded at full hours.

